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Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

April Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, March 30, 1895.

The April Meeting of the Guild of Gas Managers will be held in Young's Hotel, Boston, Mass., at noon, 13th inst.

A. K. QUINN, Secretary.

[OFFICIAL NOTICE.]

April Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, March 28, 1895.

The April meeting of the Society of Gas Lighting will be held at The Arena, No. 39 East 31st street, on Thursday, the 11th inst., at 3 P.M.

FRED. S. BENSON, Secretary.

BRIEFLY TOLD.

CLEVELAND'S FIRE CHIEF ON THE PROPER PLACE TO LOCATE GAS METERS.—The proper place to locate a gas meter has often caused discussion amongst gas engineers, not only when they were trying single-minded to reach a satisfactory conclusion, but also when they were assembled in convention; and we might make bold to say that all this cloistered thinking and open discussion have resulted in a pretty good understanding as to where a meter should be placed so that it might best perform the work for which it is destined—the being a reliable arbiter between the consumer and the company as to the quantity of gas bought and the quantity of gas sold. There are others, however, who have considered this question, and the latest and most prominent of the "others" to address himself to the matter seems to be Mr. Dickinson, of Cleveland, Ohio, who, as its Chief, directs the operations of the Fire Department of that city. Mr. Dickinson contributed an article, bearing the caption, "Fires from Gas Meters," to the March 20th issue of the *Western Fireman*, in which the doughty fire battler talks at length, and at random, on the gas meter as an agent for adding to the continued terrors of a fire for which the gas meter was not primarily responsible; but on such portions of his rambling remarks we have no particular criticism to make, since he does not in them attempt to lay down the law as to where the meter should be placed. Naturally, though, he has to "conclude his tale," and it is the "conclusion" which will appeal to the gas maker with the greatest force. This is the way in which he does it—his remarks having particular reference to the placing of gas meters in "structures used for stores and offices, flats or tenement blocks:" "All firemen know it not infrequently happens that while the ceiling and upper portions of the walls of a room may be seriously injured by fires, the carpets and the smaller articles nearest the floor are scarcely discolored by it. Therefore, it follows, in view of the volatility and inflammable character of the component parts of illuminating gas, the frail, imperfect construction of gas meters, and their weak connecting pipes, that, instead of elevating the meters on high shelves, or bunching them in the obscure, dark and extra-hazardous locations named, they should be separated and placed on the floor of each room, or in the suite to be lighted with gas, and in that way to reduce to a minimum the possibility of any extended fire from them. If found impracticable thus to separate and locate the gas meters in any building,

the very best place for them is on the roof of every building wherein gas is used for illuminating purposes. There the meters can be placed, either separately or without limit together, with absolute safety, and the peril to firemen, with which their menacing presence in any other locality constantly surrounds them, be at once and forever removed and ended." There; you have it. The whole thing "forever removed and ended," without trouble and with despatch. Perhaps Chief Dickinson is sincere; beyond doubt he is original. And, admitting the latter—but keeping in view the fact that the main object of a meter is to register the gas that the consumer is using when his premises are not ablaze—would not the gas man who suggested that a water tank, provided for the purpose of helping to flood a building that was ablaze, should be placed in the cellar, be just as original as Cleveland's Fire Chief, and equally near to the mark?

THE AMERICAN METER COMPANY RESUMING WORK IN ALL OF ITS DEPARTMENTS.—Last week we had occasion to report the going out of men employed in the New York and Philadelphia shops of the American Meter Company, and also to note that the Company was unable then to take orders for prepayment meters or for repair work. The strike, so far as the old hands and the Company are concerned, remains as before; but the Company has reached the point where it is enabled to furnish prepayment meters and to accept orders for repairs, without undue delay in the completion of orders on either account. Of course, the Company can fill orders for meters of the ordinary type with its customary promptitude.

CARBIDE OF CALCIUM.—This interesting subject still attracts great attention amongst gas manufacturers and gas consumers, although we imagine the former have reached closer views respecting its value to them than have the latter respecting its possibilities for them. Our columns of late have contained the newest matter regarding it—our current issue holds the closing chapter of Mr. M. P. Wood's speculations or studies about it, and further on will be found the remarks made by Mr. W. W. Goodwin on the subject before the Springfield meeting of the Ohio Association. Both the Wood and Goodwin presentations are readable and instructive, particularly that by the former; but from a careful sifting of that which has come before us, we incline to the view that Mr. Frederic Bredel's calculations (published in the JOURNAL for February 25) anent the cost of producing the material—which he puts at $40 per short ton—are closer to the truth of it than is in anything yet published on the subject in this country. Any error in Mr. Bredel's estimates must be put to an under rather than to an over-valuation of its cost, for it seems quite likely now that $50 per ton on an output per day of 15 tons, would be a low figure for the electrolytic production of this material. Ultimate waste of fuel in the development of the energy required is the stumbling block, and the obstacle appears to be one that is insurmountable. It is quite possible that the Society of Gas Lighting, at its meeting for April, will have presented to it some facts respecting carbide of calcium that have not been brought forward by its putative discoverer, Mr. T. L. Willson.

NOTES.—The Cincinnati Gas Light and Coke Company has declared its usual quarterly dividend of 2½ per cent., payable to day.——The office quarters of the Peoria (Ills.) Gas Light and Coke Company have been removed to the commodious store building, adjoining the offices of the Peoria Water Company, on North Jefferson avenue.——Manager S. J. Fowler, of the Springfield (Mass.) Gas Light Company, has entered into a contract with the United Gas Improvement Company, under which the latter will construct two sets of its standard double superheater water gas settings, each set to have a daily capacity of 500,000 cubic feet. The apparatus will be placed in a new building adjacent to the present retort house and coal sheds. The natural growth of Springfield proper, and the purpose of the Company to supply gas in the suburb of West Springfield, forced Mr. Fowler to consider the matter of enlarging his manufacturing facilities, and the result is the adoption of a water gas annex. The United Gas Improvement Company's contract also calls for the placing of scrubbing apparatus, and it is likely that larger purifiers, station meter, exhauster, etc., will also be arranged for.——The hearing before the Board of Gas and Electric Light Commissioners, on the petition of certain residents of Brockton, Mass., for a decree reducing the price and increasing the quality of the gas supplied by the Brockton Gas Light Company, was held on March 20, before the full Board, Mr. Warren A. Reed appearing as counsel for the petitioners, the Gas Company being represented by Mr. Hardy F. Atwood. The notable things about the hearing were: The failure of the signers to appear in person, and the development of the fact that the average candle power of the gas supplied by the Company in 1894 was 22, whereas the statute prescribes 16-candle power as the minimum. The Commissioners have the case under advisement.

[Concluded from page 404.]

Studies in Carbide of Calcium.

[Prepared for the JOURNAL by MR. M. P. WOOD, M.E.]

Prof. V. B. Lewes gives the illuminating power of acetylene, as compared with other hydrocarbon gases, for the standard consumption of 5 cubic feet per hour, burned under one inch water column pressure in the burner best suited for it, viz.:

Methane or marsh gas, CH_4	5.2	candles.
Ethane, C_2H_6 / Propane, C_3H_8 } $C_nH_{2n}+2$	35.7	"
	56.7	"
Ethylene, C_2H_4 / Butylene, C_4H_8 } $C\,H_{2n}$	70.0	"
	123.0	"
Acetylene, C_2H_2, $= C_nH_{2n}-2$	240.0	"

This data is somewhat at variance with that furnished by "King's Treatise on Coal Gas," where we learn that Drs. Clegg, Rogers, Letheby, Frankland, Attfield and other experimental chemists, contemporary with Sir Humphrey Davy, analyzed coal gas and defined the characteristics of its substances so thoroughly that the later day chemists have had but little to do except to verify their deductions and to abridge their methods of analysis. Their deductions were: If the illuminating power of olefiant gas or ethylene (C_2H_4) be taken as 1, acetylene = 1, propylene = 1.5, butylene, quartene or tetrylene = 2.

The greater part of the hydrocarbons found in coal gas are decomposed at comparatively low temperatures—2,000° to 2,200° F., and are no doubt changed in some degree into acetylene. The recorded experiments of Bethelot, Odling, Mathiessen, McLeod, Reish, De Wilde and others all show this property in coal gas, viz., to break up the heavier hydrocarbons into the series next above them on the application of a moderate degree of heat and a comparatively short period of exposure to it; but the non-luminous zone of an ordinary gas burner is much too small and the period of exposure too short to afford any gaseous substance much chance to change its character *en route*, and the carbon elements no doubt are ignited and consumed at once at the burner, without much reference as to their source, whether from the $C_n\,H_{2n}-2$ (acetylene) or the $C_n\,H_{2n}-6$ (benzine) group.

The various processes for the manufacture of gas from crude petroleum, or enriching water gas by the decomposition of naphtha, all owe their strong enriching power to these two groups of hydrocarbons, and, as a general rule, gas managers have heretofore given preference to those enriching substances in which the benzine hydrocarbons predominate.

Ordinary coal gas contains from 1½ to 2 per cent. of benzole, to which 60 to 70 per cent. of the illuminating effect is due. When fully saturated, coal gas will carry 3 per cent. of benzole, each 1 per cent. of which adds about 8 candles to the gas with which it is mixed. Water gas absorbs more than this amount, but the average American practice does not require over 30 pounds of crude oil, or gas naphtha of any specific gravity from 44° B. to 70° B., to bring a blue water gas up to 28 or 30 candle power.

The molecular formation of benzole (C_6H_6) contains three atoms of acetylene condensed into one. The heat unit powers of the two gases compared are, per cubic foot, burning to watery vapor (Thomsen's formulæ): Acetylene, 1441.4° F.; benzole vapor, sp. gr., 2.7, 3594.60° F. According to the heat unit view, benzole should give 2½ times the light of acetylene, but, according to Dr. Frankland, it only gives twice the light of C_2H_2.

The vitiation of the air in a room lighted by various methods to obtain the same quantity of light is manifestly less with the use of acetylene than by any other method: Thus:

Burner Used.	Gas Consumed.	Carbonic Acid Produced.	Number of Adults in Room to Produce Same Vitiation of the Air.
Flat flame No. 4.....	19 cu. ft.	10 cu. ft.	16.
" " 5.....	22.6 "	12 "	20.
" " 6.....	25.2 "	13.2 "	22.1
Argand.....	15.2 "	7.9 "	13.
Acetylene.....	1.2 "	2. "	3.6
Kerosene oil lamp....	....	....	22.3
Sperm candles(40 used)	....	....	27.3

The flame of acetylene, notwithstanding its high illuminating power when burned pure, is distinctively a cool flame, approximating 1,700° F., while an 18-candle power coal gas flame will be 2,200° F., and in some cases higher.

From the data furnished by the Electric Gas Light Company, an electrical horse power of energy in the form of incandescent lights, compared with the same amount of energy in the form of calcium carbide

gas, will be about as 7 to 11; but these deductions must be received with some caution until a more extended use of the carbide will enable them to be verified.

This difference is not, however, sufficient to enable a steam generated carbide and acetylene light to compete with an electric incandescent light; it would not cover the extra labor and other drawbacks to gas light.

Although for the same power expended in light production on the above ratio of 7 to 11, it by no means follows that it would be profitable to manufacture calcium carbide at electric supply stations; the handling of the materials, delivery of the carbide, its package and storage, and delivery in small lots to isolated installations could never be met by this difference in the power consumed. Other persons' experiences in electrical matters indicate that the difference as above would be nearer 4 to 5, when using incandescent lamps of 4 watts per candle power. With lamps working at 3½ volts per candle power for power, the lights will be equal.

With arc lamps the conditions are completely reversed, for an ordinary arc of 10 amperes at 45 volts, with a globe and a resistance, will furnish one candle light for two volts energy, thus making the light for the same power equal to 80 for the electric arc and 50 for the acetylene light.

Of the heat produced by coal in a boiler furnace driving a steam electric plant, only about five per cent. is recoverable in an electric furnace, hence, the impossibility of economically working electric furnaces by steam power, except when the product, whatever it may be, commands a comparatively high price.

The 180 electric horse power required to produce a ton of carbide in 12 hours, means 135 units of electrical supply, and the lowest prime cost of such a unit from a central station will be 4 cents; hence, the power cost per ton of carbide will be $5.40, or nearly 10 times the estimates of cost furnished by the Electric Gas Light Company.

If an adequate supply of water power can be had at 50 cents per horse power for 180 horse power per year, the cost of acetylene gas will be about as its advocates claim for it, *i. e.*, one and a half dollars per 1,000 cubic feet. If the above price will buy 13 units of electricity in the form of incandescent lights, which at 4 watts per candle power give 3,250 candle power, then 1,000 cubic feet of acetylene will give for the same money, 28,000 candle power for one hour.

As stated by the Electric Gas Light Company, a ton (2,000 lbs.) of the carbide furnishes the equivalent light units of from 80,000 to 100,000 cubic feet of 22 to 26 candle power illuminating gas; this duty being that due to a 40 per cent. air and a 60 per cent. gas mixture. The pure acetylene from a short ton of carbide equals 8,000 to 10,000 cubic feet of approximately 240 candle power gas. These statements of quantity and candle power are derived wholly from the Electric Gas Light Company, and have never been verified by any one not ostensibly in their interest, and cannot be until the production of carbide on a commercial basis enables experimenters to determine the qualities of the product unbiased by personal considerations.

The gas has a distinctive smell, and in case of leakage can be detected by its disgusting order, which can be attributed to the facility with which it absorbs sulphur compounds and forms mercaptan, C_2H_2Hs, an ounce of which will impart a decided odor to 300,000 cubic feet of carbonic oxide or marsh gas.

As an enricher for hydrogen or water gas, instead of crude oil or naphtha, its use on an extended scale is assured so soon as the item of expense is brought to approximately the same basis. It requires from 4½ to 5 gallons of gas naphtha to be mixed with ordinary blue or water gas to produce 1,000 cubic feet of commercial illuminating gas. This naptha costs from two to four cents per gallon, according to the location of the gas works using it. A 200 candle power pure acetylene gas used as a substitute enricher for the same blue gas would require 150 cubic feet. When this can be furnished at or near the expense of the naphtha, as above, the use of acetylene will be assured, as it has the elements of less risk from fire, less space required in the gas works for its generation, less purification, less coal or oil fuel, steam and other minor points in its favor.

Assuming that calcium carbide can be produced and sold at a profit at the price given by the Electric Gas Light Company, viz., $15 per short ton (which price is problematical), the expense of the acetylene enricher of 200 candle power will be 21½ cents per 1,000 cubic feet of commercial illuminating gas, and is approximately the same as the cost of the naphtha enricher.

When acetylene is used as an enricher for coal gas, three per cent. raises the candle power from 16 to about 22 candles, and materially whitens the flame. With natural gas, each one per cent. of acetylene added as a carbureter increases the candle power from three to four candles, and adds slightly to the heat unit power of the gas, about six per cent., giving a light of 20 candle power and odorizes the gas markedly.

With blue, or water gas, the results of acetylene as an enricher are not so favorable. Experiments have not yet determined the ratio of admixture between the two gases for any given candle power. Thirty per cent. of acetylene mixed with water gas fails to bring the candle power up to 20, while the same per cent. of gas naphtha vapor yields a 30 candle gas.

Acetylene diffuses itself thoroughly with coal gas in the holder or with natural gas in the mains, but with water gas it may require some process of fixing not yet determined.

As before stated, the evolution of gas from the carbide will proceed so long as water or watery vapor reaches it, and there can be no doubt of the excessive pressure that can be reached in the carbide generator from this feature of the substance. It requires 1,132 lbs., or 135.722 U. S. gallons of water, to fully hydrate 2,000 lbs. of CaC_2, bearing two to three per cent. of free hydrogen. This accumulation of pressure must be guarded against not only by automatic devices to govern the inlet of water to the carbide in the generator from the rise and fall of the gas holder, but by a relief or safety valve on the generating vessel with a discharge to the open air away from any fire or gas light flame that might act the part of a pilot flame to set off the whole plant. This discharge pipe should also be hooded and covered with a fine mesh wire netting to cut off any tendency to back fire in the escaping gas. The use of copper, brass or composition pipes and fittings must be avoided to prevent the formation of acetylide, as before stated.

The present stock of carbide is the product from an electric furnace under the control of the Electric Gas Light Company, and there are no means to verify any statements that may be made by them as to the amount of material used or the product from any given amount of electrical energy.

As stated, two short tons of pulverized coke (of a quality suitable for the manufacture of electric light carbon pencils) is mixed with 2½ tons of pulverized quicklime—good builders' lime, as free from air slack as possible. This material is put into an open electric furnace, built of ordinary firebricks, the walls being 9 or 13 inches thick, and of any convenient size, say, 5 feet inside diameter. A cathode connection is made from the iron base plate of the furnace to the dynamo, and the positive pole from the dynamo is connected to the carbon stick (one or more) that enters the open mouth of the furnace and is made adjustable in any convenient manner. A quantity of the above material is put in the furnace, the current turned on, and, as fusion ensues, the pencil is adjusted to meet the conditions in the furnace. The product, in the form of the slag-like carbide, is run off through the taphole in the side of the furnace, and the process is continuous so long as material and electrical energy are supplied.

For each charge as above of 4½ short tons of lime and carbon, two short tons of carbide are produced, requiring an electrical energy of 75 volts and 2,000 amperes—or, approximately, 200-horse power in a 24-hour day; or, 1-horse power electrical energy produces 10 pounds of carbide in a 10 hour day. This amount of product is equivalent to a 44 per cent. effect from the lime and carbon used, and it is doubtful if the useful effect can be increased to much over 50 per cent. of the materials charged. The waste in the furnace must necessarily be large, the reactions therein simulating those of the open hearth, basic steel process, wherein any sulphur that may be in the coke, and any phosphorus that may be in the lime, under the influence of the high heat, will take up their saturated amounts of calcium and be fluxed or vaporized. A further reaction is also shown in the use of the carbide. When exhausted from its gas producing qualities, the waste lime, when inclosed in a close vessel for a short time, develops a noticeable odor of ammonia, that may possibly be enough in amount to warrant saving as a fertilizer. Experiments are in order on this point, independent of the Electric Gas Light Company.

Estimates of the cost of producing carbide presented by the aforesaid company must be received with extreme caution. That any considerable amount of water power convenient to lines of transportation can be had for $5 rent per horse power per year is problematical. It will probably average nearer to $10 per year, if not $15.

A modern steam power electrical plant, of, say, 2,000-horse power, will require about 9½ square feet of floor surface for its development, and will cost, with foundations, about $17 per horse power.

A high speed engine and boiler plant, stack, pumps and all the auxiliaries complete will cost $55 per horse power.

The electric plant, dynamos, wires, with all instruments and connections ready for work, will cost $40 per horse power.

Crushers for lime and coke, line shaft, fans, tools, elevators, storerooms for lime and carbide, cooperage, stables, horses and drays, land (5 acres), grading, interest and expense account during construction, will require $25,000, or a total capital cost for a 2,000-horse power steam plant of $250,000.

Upon the basis of 200-horse power producing 2 tons of carbide per 24-hour day, the above plant would produce 20 tons of carbide daily.

The cost of operating the above steam plant, using 3 pounds of coal per horse power per hour for all purposes (other than for the carbide carbon), at $1 per ton, cartage of ashes, water, labor and all engineering items, salaries, interest, insurance and depreciation upon the building and machinery accounts will be $153 per day for a 310-day year.

The dynamo department, including the depreciation, interest, insurance and a proportional part of all office salaries and expense accounts, will be $61 per day, or a total cost for the power and dynamo departments of $214 per day to produce 20 short tons of carbide, equal to $10.70 per ton, with coal at $1 per ton.

For each dollar added to the price of coal per ton, add $3.60 to the above cost of the carbide.

The pulverized lime at the furnace will cost by the quantity at least 16 cents per bushel of 80 pounds, or $4 per ton of carbide. The pulverized coke for the carbide will cost $2.50 per ton of carbide.

Labor and other items at the furnace and a proportional part of all office expenses, insurance depreciation, repair of furnace, tools, etc., will be $2.50 per short ton of carbide.

The total cost of the carbide from a steam plant, with coal at $1 per ton, thus equals $19.70 per short ton. The same quantity of carbide from a water power plant, on the basis of $5 per horse power per year rent, will cost $16.10 per ton, with an additional charge of about 33 cents per ton for each dollar per year water rent over a five dollar rate.

These are cost prices of the carbide at the manufactory, and do not include any allowance for cooperage and package, royalties, legal expenses, profits to the manufacturing company, etc.

With some contemplated improvements in the electrical service, together with a reduction of the furnace waste and a low rate of wages for all employees, with a location of the works away from all competing employments for labor, it may be possible to produce the carbide for a commercial price of $24 per ton, f.o.b., but this price will only obtain under extremely favorable conditions and for large quantities, and can in no case afford a base to estimate upon for any change from naphtha to a carbide enricher for a water gas plant. To substitute acetylene enricher for naphtha for the gas used alone in the city of New York would require over 600 tons of carbide daily, to produce which quantity will require over 120,000-horse power of electrieal energy in a 10-hour day.

A caution to experimenters with acetylene is in order, and here given. A late number of *La Nature* contains a communication from Prof. L. Meyer to the "Berichte," and which carries the following warning note against danger from the admixture of acetylene and oxygen, particularly in necked vessels or chambers, many serious accidents having lately arisen by the explosion of eudiometer tubes:

"It has long been known that acetylene mixtures explode with great violence. Prof. Meyer, in conjunction with Prof. Seubert, in 1884, showed that mixtures of acetylene and oxygen ignite at lower pressures than all other combustible gases, a pressure of 32 millimeters of mercury (=.537 inches of water column) being sufficient to enable it to explode, while hydrogen and oxygen require a pressure of at least 100 millimeters; carbon monoxide and oxygen require over 200 millimeters. This, however, is not sufficient to account for the enormous pressures developed in open cylinders. Moreover, it cannot be due to the more rapid rate of propagation of the explosion, for M. Berthelot and Prof. Dixon have independently found that the rapidity of the acetylene detonating mixture is but slightly greater than in the mixture of oxygen and ethylene or marsh gas, and much less than mixtures of hydrogen and oxygen. Prof. Meyer suggests that the smaller amount of "hydrogen contained in acetylene than in the other hydrocarbons resulting in the production of less watery vapor and relatively more carbon dioxide, together with the fact that the theoretical temperature of combustion, calculated from existing thermal data, is extremely high in the case of acetylene, may afford some explanation of the extraordinary energy developed during the explosion of the latter."

This data refers solely to the use of pure acetylene and oxygen mixtures. When atmospheric air is used as the source of the oxygen supply, the dilutent effect of the nitrogen reduces the rapidity of combustion and modifies greatly the explosive effects. It is well to bear in mind, however, that the temperature due to explosive mixtures of this gas and air will be very high, if the mixtures are used in gas engines (and the use of it for this purpose appears to be a foregone conclusion) and the cylinder pressures *will exceed those heretofore obtained*, and must be provided for on a different basis than that of a producer gas, or the ordinary 20 odd candle power illuminating gas.

The explosive force of carbonic oxide, mixed with the theoretical amount of oxygen gas to ensure perfect combustion, and confined in a vessel of adequate size to contain the volume of the gases before combustion, with no allowance for expansion, is equal to 22.2 atmospheres, or 281.94 pounds per square inch gauge pressure. With atmospheric air as the source of the oxygen supply, and the same conditions relative to non-expansion, the pressure will be reduced to 12.65 atmospheres, equal to 185.955 lbs. per square inch. With a mixture of hydrogen and pure oxygen under similar conditions, the pressure becomes 25.1 atmospheres or 368.97 lbs. per square inch. Suitable precautions in the use of acetylene will be apparent from the above comparative data.

Domestically, the success of the carbide process for manufacturing gas seems to be well assured at any price for the carbide under $30 per ton. If a ton of the carbide produces the equivalent light units of 100,000 cubic feet of, say, 22 candle power gas, when mixed with 40 per cent. of air, the cost of the gas will be only 30 cents per 1,000 cubic feet, and the heat unit power will be approximately 900° F. per cubic foot.

The demand for the carbide from isolated plants, hotels, manufactories, country houses, etc., should be almost as unlimited as for coal.

The cost of installation for 30 to 40 light houses already piped for gas, will be about $5 per light when an air mixer and meter is used for a mixed gas. Without the mixer and with the use of pure acetylene the cost will be about $3.50.

Under the average conditions of domestic service and attendance it would probably be safer to use the acetylene gas pure or without the air admixture. It would require but a very little disturbance in the working of the mixing meter or the gas governor attached thereto, to reduce the proportions of 40 per cent. of air and 60 per cent. of gas to that of 20 per cent. or less of air, when an explosive compound would be formed that would be more or less violent, the maximum explosive effect being reached at some point where 10 per cent. of air is mixed with the gas.

The patents that are now in existence and that are alleged to cover the manufacture of the calcium carbide are:

1st. No. 486,575, Nov. 22, 1892, to Thos. L. Willson, Leaksville, N.C.
2d. No. 491,394, Feby. 7, 1893, " " " "
3d. No. 492,377, Feb. 21, 1893, " " " "

First—No drawings. Specimens deposited show aluminum compounds; nothing to indicate carbide compounds or formation. "Process of electrically reducing refractory compounds." Claims—Describes a process of reducing pulverized refractory metallic compounds by saturating them with hydrocarbon liquids and subjecting the impregnated compounds to the heating action of an electric current.

Second—No specimens. One drawing of a crucible or pot furnace, with an iron plate cathode connection to the dynamo, and a carbon electrode connection to the positive pole of the dynamo. "Process of electrically reducing aluminum and forming alloys thereof." Claims describe the action of the electric current on the bath of bare metal to be alloyed to the aluminum in the presence of pulverized carbon, which acts with the oxygen freed by the decomposition of the alumina and prevents corrosion of the carbon electrode, the cathode and crucible. The liberated aluminum being dissolved in the bath of base metal forming an alloy of the same.

Third—No specimens. One drawing of an open mouth furnace, built upon an iron plate forming the cathode connection to a dynamo, the adjustable carbon electrode entering the open mouth of the furnace and being connected to the positive pole of the dynamo. "Electric reduction of refractory metallic compounds." Claims the process of decomposing refractory compounds, which consists in subjecting the compounds while commingled with subdivided carbon in sufficient proportion *to prevent the formation of a bath of fused compound* to the continued heat of the electric arc, between separated electrodes, which are adjusted to prevent the fluctuation and resistance of the arc *from forming a bath of fused compound.*

Inasmuch as the rulings of the courts of late years have been against ambiguity in patent claims, and require that the process or product patented shall be so clearly set forth that persons ordinarily versed in the art can construct and manufacture the same without the aid of specially trained expert service; also, that all mechanical and chemical equivalents of the article patented shall be named separately and distinctively, and not be embraced under the general scoop net "*its equivalent thereto*," as was the practice of inventors a few years ago, it seems doubtful if the claims of the carbide people for the production of calcium carbide electrically can be sustained without some material addition to

their patents other than is now made public, in which there is not the slightest reference to the production of carbide other than that embraced in the term "metallic compounds," and it is also of note that not an ounce of carbide was ever produced by Willson until long after the above patents had been issued.

The plant in North Carolina that has heretofore produced all of the carbide, has been dismantled, preparatory, it is supposed, to its Phœnix rise at Niagara Falls, but as appears from the *Journal of Gas Lighting*, March 12, 1895 (see also *Engineering and Mining Journal*, March 21,[1895), the State right business is still in full blast, and the projectors of the carbide interests are industriously gathering in the shekels while the skies are yet bright.

It may be that the story of the accidental discovery of the late "greatest chemical curiosity" may yet take place alongside of those other noted great events in the world's history, the kerosene lamp and the kicking cow that caused the great Chicago fire; the South Sea Island bubble; the tulip bulb, or even the Keely motor craze which still lives in our midst and is desirous of being hitched onto something where it can safely exert its power, and no better object for this is now in view than the cheap production of metallic carbides for the production of gas.

Something from the 1894 Report of the Inspector of Gas Meters and Illuminating Gas, of Massachusetts.

The following interesting facts and figures are from the annual report (1894) of Mr. Charles D. Jenkins, Official Gas Inspector of Massachusetts:

During the year ending Dec. 31, 1894, 25,021 meters were inspected. This is a much larger number than usual, and is due to the large number taken by the Brookline Gas Light Company. There were 24,417 new or repaired meters presented for inspection by the manufacturers or Gas Companies, as the law requires all new or repaired meters to be inspected and sealed by the State Inspector before being used to measure gas to consumers. A few of these, being found to register incorrectly, were returned for adjustment and then retested.

There were 604 meters reinspected, which, being in use, were suspected of being incorrect by either the consumer or Gas Company. The law provides in this case that either party may ask for an official reinspection. Of these meters 327 were correct within the legal limits of 2 per cent. fast or slow, and were resealed. The fast meters numbered 217, the average error being 4.70 per cent.; there were 55 slow meters, the average error being 8.56 per cent.; 4 meters would not register and 1 would not pass gas. The average error of the 599 meters was .99 per cent. fast. Of the 217 fast meters, 36 were more than 5 per cent. fast, 3 more than 10 per cent., and 1 was 36 per cent. fast. Of the 55 slow meters, 19 were more than 5 per cent. slow, 3 more than 10, 3 were 16, 4 were 25, 1 was 26, and the slowest was 32 per cent. slow.

During the investigation into the methods of the Gas Companies operating in and around Boston, made by the Board of Gas and Electric Light Commissioners in March, in response to an order of the General Court, a number of meters were tested at the Board's request. These meters were selected from lists, furnished by the Board, of consumers whose bills had increased in the second period, that of reduced price, over those of the corresponding period the previous year. The following table gives the results:

Company.	Number of Meters Tested.	Average Error Per Ct. Fast.
Boston	43	1.51
South Boston	27	0.80
Dorchester	25	0.66
Roxbuy	8	0.06
Chelsea	20	2.65
East Boston	22	3.93
Brookline	5	1.00

Average of the 150 meters, 1.65 per cent. fast. Average length of time since last inspection (meter either new or repaired), 6.69 years. Only four-tenths of 1 per cent. of the meters in use by these Companies were tested, and these, too, were meters of consumers whose bills showed an increase when a decrease would have been expected. These are severe conditions, and fast meters would be more liable to be found than if an equal number had been taken of consumers whose bills had decreased; the average error, 1.65 per cent. fast. is within the 2 per cent. limit allowed by law. The Companies whose meters showed greatest variations have generally had high ammonias, as shown by the following table, the results being grains per 100 feet of gas, the maximum allowed by law being 10 grains, and the average being that of the larger Companies.

	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.
Av'ge, State.	2.84	3.19	3.65	2.98	3.51	3.88	3.08	2.59	1.91
East Boston..	5.76	6.70	6.39	4.71	7.14	7.72	11.26	7.86	2.37
Chelsea.....	2.21	2.34	3.50	1.20	6.87	13.39	7.46	5.87	3.49
So. Boston ..	6.90	5.82	9.59	8.23	8.72	5.78	4.46	4.17	3.05

These companies are taking the ammonia out now, as shown by the late tests. South Boston furnishes water gas, which contained little if any ammonia, and East Boston and Chelsea have put in suitable apparatus to remove it.

Five meter provers have been standardized and two old ones retested the past year.

The law provides that the gas of every company supplying illuminating gas to more than 50 consumers shall be tested at least twice a year, and that an additional insection shall be made for every six million feet of gas supplied, but the inspections must not be made oftener than once a week. No notice is given the companies of intended inspections, which are made at irregular intervals, so that no preparation can be made, if the companies were so inclined. The majority of inspections is made during the winter months, so as to follow the consumption to an extent. The minimum candle power allowed is 16; the standard English candles, corrected to a rate of burning of 120 grains per hour, being used, and the gas burned at the rate of five feet per hour. The coal gases and mixed coal and water gases are tested with the standard Sugg's "London Argand" burner, size "D" generally being used; the higher candle power water gases are tested with the Sugg's "table top" open burner, six feet size. The pure petroleum gases are burned through small lava-tip open burners, of from three-quarters of a foot to 2 feet per hour capacity, the results being calculated to an hourly rate of five feet; for the petroleum gases mixed with air both Argand and lava-tip burners are used, depending on the amount of air in the mixture. Twenty grains total sulphur and ten grains of ammonia per 100 cubic feet of gas are the maxima allowed of these impurities; no sulphureted hydrogen is allowed.

The inspection of the gas of the larger companies (24 in number) showed an average candle power of 20.47—maximum, Brookline, 26.63; minimum, Newton, 17.59; and of the smaller (35 in number), an average of 18.49—maximum, Amesbury, 23.73; Wakefield, 16.63. The average of the oil gas companies (10 in number) was 31.48.

* * * * * * * * * *

Leaving out the oil gas companies, the averages of the State were: Candle power, 19.31 (an increase of .39); sulphur, 9.47; and ammonia, 2.57. The larger companies' average increased 1.01 candles over last year, while the smaller companies decreased .05 candles. The sulphur increased in both large and small companies, while the ammonia decreased in large and increased in smaller companies. The 39 coal gases averaged 17.98—an increase of .12 candles; the 11 water gases averaged 23.64; and the 9 mixed coal and water gases averaged 19.63.

At Gloucester, Plymouth, Manufacturers' of Fall River, Westfield and Fitchburg the tests have been made at the works, as being the most available places. The Company at Fitchburg has just put in a photometer at its uptown office, which will be used in the future. It is expected that Gloucester and North Adams will put in photometers this year. The Brookline testing station has been moved into Boston; the Dorchester station to the disused Dorchester works, on account of the difficulty of heating the room formerly employed.

The following eudiometric analyses have been made during the year. The first two are water gas, the third mixed water and coal, the next four coal gas. Waltham introduced a new process in September, and the eighth sample is some of the new gas; the high nitrogen has since been reduced by adding coal gas.

Place.	Candle Power.	Illuminants.	Marsh Gas.	Hydrogen.	Carbonic Oxide.	Nitrogen.	Oxygen.	Carbonic Acid.
Boston ...	24.9	16.59	19.78	32.07	26.10	2.42	—	3.04
Brookline.	26.4	15.92	26.09	26.73	26.15	2.04	—	3.07
Lynn.....	19.4	9.39	28.74	42.56	15.74	1.48	—	2.09
No. Adams	18.7	5.87	39.14	46.73	6.99	1.27	—	—
Taunton..	17.4	4.82	35.86	52.00	5.80	1.44	—	0.08
Newton ..	17.2	5.14	34.55	48.96	7.26	3.14	—	1.00
Newton ..	17.3	5.18	35.47	48.73	6.25	3.00	0.13	1.24
Waltham.	21.7	19.17	34.52	10.70	0.82	34.22	0.15	0.42

The question of temperature of the photometer rooms having arisen during the year, some experiments were made to determine whether the temperatures were an important factor, and, if so, to what extent. The method was to burn the gas under the same conditions, as nearly as possible, as in photometrical tests, with an air supply the temperature of which could be easily changed. To the perforated bottom of a large lantern was attached an air chamber, supplied with thermometers and

a window for observations. The gas burner in the lantern was put as near the bottom as possible, so that the temperature of the air did not change from the thermometers to the immediate vicinity of the burner. This was shown to be the case by experiment. Air was supplied to this chamber through a large pipe, one section of which was provided with tubes which could be heated by gas in order to raise the temperature of the incoming air; suitable baffle plates insured uniformity of temperature by thoroughly mixing the air, and also prevented an unsteady supply to the burner. The lantern was lined with black velvet, to prevent reflections. The candle power was taken with the portable photometer, using the Edgerton standard, frequently standardized against candles. Care was used to keep the room at 60° F. during the series of tests. The first table gives the results obtained with a water gas burned through the open testing burner, Sugg's "table top," the second table the results using an Argand with coal gas, the results in each case being the average of a number of determinations:

Open Burner.

Temperature. (Degrees F.)	Observed Candle Power.	Corrected Candle Power.	Increase or Decrease.	Percentage Increase or Decrease.
30	8.46	19.27	2.92 Dec.	13.2
35	8.82	20.09	2.10	9.5
41	9.02	20.56	1.63	7.3
50	9.46	21.55	0.64	2.9
56	9.70	22.10	0.09	0.4
60–66	9.74	22.19	..	..
72	9.91	22.57	0.38 Inc.	1.7
81	10.10	23.01	0.82	3.7
89	10.26	23.36	1.17	5.3
100	10.84	24.69	2.50	11.3

London Argand Burner.

Temperature. (Degrees F.)	Observed Candle Power.	Corrected Candle Power.	Increase or Decrease.	Percentage Increase or Decrease.
35	8.84	16.26	0.17 Dec.	1.0
41	8.85	16.28	0.15	0.9
47	8.87	16.32	0.09	0.5
56	8.92	16.41	0.02	0.1
61–65	8.93	16.43	..	..
70	8.94	16.45	0.02 Inc.	0.1
81	8.97	16.50	0.07	0.4
87	9.12	16.78	0.35	2.1
95	9.52	17.51	1.08	6.6
100	9.76	17.95	1.52	9.3

These results show that with the open burner and high candle power gas the temperature has a decided effect, due to the gas having an unlimited air supply, the temperature of which can easily influence the burning gas by lowering or raising the flame temperature; but with the Argand burner the construction of the burner in limiting the supply of air and heating it somewhat before combustion would tend to counteract the effect of cold air, as was found. The heated air, by adding to the flame temperature, increased the candle power noticeably. It is desirable to keep the photometer rooms between 60° and 70° F., as colder rooms will detract from the candle power, while warmer ones will increase it.

What Proportion Should Holder Capacity Bear to Maximum Output.

[Read by Mr. E. T. McCormack, London, Ohio, at the 11th Annual Meeting of the Ohio Gas Light Association.]

This question being one of great importance, and the holder and tank representing from 20 to 30 per cent. of your plant, great care and consideration should be taken in the construction of your holder at the start, and arrangements made for a storage capacity equal to the maximum daily output, with a reserve of at least from 40 to 50 per cent. This may seem large at the start, but it is not excessive for a small works where your daily demand may vary at any time. In my experience with an old plant I find this entirely different. During the past winter I have made and sent out in 24 hours, with a holder capacity of 15,000 cubic feet, 45,400 cubic feet, with a retort capacity of only 50,000 cubic feet. The greater portion of gas was made between 6 and 12 P.M. This necessitated an extra stoker, making an additional expense. This additional expense, if judicially used in holder capacity, would give relief and uniformity both in labor and manufacture—especially if you could make 2,000 feet per hour continually for 24 hours and not be compelled to slack down for the want of storage capacity.

The maintaining of retorts is considerably less with uniform work; the stoker having a better chance to keep retorts clean, and the heat for carbonization is thoroughly utilized.

With insufficient holder capacity and irregular work, your retorts become coated with carbon. The only chance for cleaning is during full moon, if you are so fortunate as to have *this* opportunity. Purification enters into this question of holder capacity, as many works are deficient. To hurry the gas through the boxes means to utilize only a part of the material before throwing the purifier out of action; on the other hand, if the area of the box be such that the gas may linger a while in its passage through the apparatus the material must take up its proportion of the impurities contained in the gas. With the gas passing uniformly through the material we get better results as to purification and candle power, and the purer the gas delivered to the burner the more friends it has, and increased consumption will generally follow for your company.

My experience with holder capacity would cover more space if other parts of the business did not require so much of my attention. I leave the subject to our members, and trust they are not in the same position we are at London.

Soft-Coal Water Gas.

[Read by Mr. W. S. Bowen, Philadelphia, Pa., at the 11th Annual Meeting of the Ohio Gas Light Association.]

Water gas is a subject that has been so ably and so fully discussed in all its bearings that any attempt to treat of the advantages of coal gas vs. water gas would not serve the purpose, so I shall pass that portion of the question and consider the question of soft coal water gas only.

The question of the use of soft coal for gas making in the usual methods of gas operations is comparatively new and is now attracting considerable attention, particularly as there is so large an area of the country in which good soft coal is available, and the use of hard coal necessarily limited in extent, the question of freight is a matter of very great import.

Soft coals, slack or nut, contain all the desirable qualities for good gas, if we but use them properly. Instead of retorting them by the old-fashioned process, why not put this coal into a cupola and, after extracting all the coal gas thoroughly and quickly, use the residual coke in one operation, without handling it, to make water gas? As the soft coal is fed in by hoppers it gives off its gas and then water gas is made, and the combination is passed to the next chamber, where sufficient oil is added to make any desired candle power. Can this be done? Let us see. I shall endeavor to describe a system of gas making which may be of interest.

The space between circular shells may be divided into any number of compartments, and, for convenience of description, say three chambers for coal generators, one for carbureting and coke treating, and one for a superheater.

The idea now is to feed the coal automatically, in homoepathic doses 50 to 60 pounds to a charge, and charges made each run, and after the coal chamber generators are hot, water gas is made by passing steam up through the incandescent coal-coked, and the combined coal and water gas thus made is conducted to the carbureting chamber to be carbureted, and passed through the coke-treating chamber for treatment, as herein explained. After treating it is "fixed" by contact with red hot firebrick in the superheater, after which the gas is ready for purification and use. What is the result? We get a gas whose constituents are coal gas, water gas and oil gas, and which for all purposes contains all the desirable qualities of all these gases, and in the manufacture of which we have used only the cheapest materials. I will here state what is an average estimate of the amount of materials used per 1,000 feet of gas made:

Bituminous coal	30 lbs.
Coke	5 lbs.
Oil	2½ gals.

Candle power, 20; heat units, 650; specific gravity, .585.

The process I have attempted to describe is different in construction and manipulation from any other now in use and aims at the following results:

To extract all the coal gas from the soft coal, first, in dropping the coal through hoppers placed on top of the machine and through a highly heated flue, directly onto the bed of hot coal, where it becomes instantly heated from the radiated heat of the surrounding heavy firebrick walls. This charging is done only at the beginning of a run, so that by the end of a run, say of 10 minutes, all the marsh gas, and much, if not all, of the heavy hydrocarbons of the coal gas, have passed off and are saved.

Especially is this so when at the same time steam is passed through the coal—the water gas taking up these gases on its way through the coal beds to the carbureting chamber. From the carbureting chamber the coal gas, water gas and oil gases are passed down through the treating chamber of coke with beneficial results. Any surplus carbonic acid which may have been generated in the former chambers is thereby changed to carbonic oxide by the well known reaction in red hot coke; and we have other results, which I shall not attempt to describe, taking place under cover of the coke treatment. Analysis gives a comparatively small amount of carbonic oxide—19 per cent.; small carbonic acid—2 per cent.; high percentage of marsh gas—23 per cent.; hydrogen, 36 per cent.; illuminants, 15 per cent.

The coal used in the generators makes a close and compact bed, and one which is free from "steam fissures," so damaging to gas making. Provision is made for a large storage of heat in large bodies of checker brick at many points in the apparatus, serving to maintain an even temperature from start to finish, and no intermittent heating and cooling of the gas occurs. Runs are made of 10 to 12 minutes, and the machine is re-heated by blast in 4 to 5 minutes. It is not my purpose to attempt any technical or scientific exposition of this system, but only to give a few practical points in regard to it. It is conceded that perhaps the best gas for all purposes of illumination, and for heating, too, except natural gas, is the ordinary coal gas, but that process is very slow, and the machinery required for a large capacity plant is expensive. Then, the illuminating power is low and, compared with the high candle power lights of the present day, it is necessary to use an expensive enricher in order to attain a desirable candle power.

Admitting the advantages to be had from coal gas as a whole, let us put the coal in a cupola, which is better for carbonizing than a retort, and use it in the best form we can, and get as a result 50,000 to 60,000 feet of soft coal water gas per ton of coal. This gives the basis of a good gas. Then let us, to use the words of a gas engineer, "build up" this gas, and we shall do it by introducing enough oil to give us any desired candle power; and as we "build up" we want to "firmly fix" these combined gases, which we do as heretofore described, passing through coke and firebrick under pressure.

It has been urged that soft coal will "bridge" in the generators, but experience shows this to be incorrect in this particular form of apparatus. Then, again, by passing the carbureted gas through red hot coke, it is urged that lampblack will be formed. This we find is not at all the case, and I have seen the plant in use where, on a make of half a million feet per day, no lampblack whatever would show on the seal. The cheap coals can easily be used; and fine coal, free from dirt, is to be preferred, because of the ease with which the particles of the coal are heated and throw off their gas. The flame of this gas is tough and clear, and the gas, as it comes from the machine, needs but little purification, as it is claimed that the coke chamber is in reality a purifier. The candle power, as stated, gives us about 8 candles per gallon of oil, and the gas is a "fixed gas" in every sense and easily withstands the coldest temperature without loss. In short, the system is:

1. Not the common practice of making water gas, and then carbureting it with oil, but a coal gas and water gas, which are carbureted and treated, or "built up."

2. It is not the same as making oil gas, water gas and coal gas in separate machines and mixing them; but the complete gasification of soft coal and the manufacture of water gas, and carbureting the same, and "building up," are all one operation, thereby saving a large percentage of the illuminants and marsh gas which takes the place of decreased percentage of carbonic oxide and carbonic acid. No special effort has been made to save tar, from the fact that the amount is so small, the tar vapors being converted into merchantable gas.

But the use of this apparatus in connection with natural gas has brought the question of heating by gas out very strongly, and very much of interest has been the result; during the past winter there has been an opportunity of testing the matter fully and in all its different aspects. The plant referred to was erected at Louisville, Ky., and for the past winter was frequently called upon to help out the supply of gas when the natural gas became short for any reason. When the pressure begins to drop, the artificial plant is turned on. It is, as it were, kept "on tap," and only such gas is made as is necessary to keep the low-line pressure up to the standard, which in this case is 8 to 9 inches.

The plant has a capacity of 50,000 feet per hour; the holder capacity is 40,000 feet, and the purifiers are in the holder, the capacity per hour of which has not been limited; but for our purpose is ample for the work to be performed.

As described in a former part of this paper, soft coal or coke and oil are used; and I will state here that the working of the coal we used, which was largely "Jellico," a native Kentucky coal, and the results as to gasifying and general work of the generators, were all that could be desired.

The soft coal makes a close, firm bed, and is free from the annoyance of clinker, and we found no trouble whatever in that direction.

Now, as to the work of the plant:

On December 28 last, and for several days thereafter, we were called on to make a very large quantity of gas, as it was very cold, and the first regular time at which the machines were called on to work full capacity. Fifty thousand feet per hour was easily made, however, and kept up for several hours at a time each day. The mixing of artificial gas and natural gas was perfect, and no complaint came from users of the same. The weather moderated then, and no gas was made until January 12, when, with the thermometer at 10° below zero, we made 600,000 feet in 12 hours, and the record for coal was 21 pounds; coke, 2.7 pounds; oil, 2.73 gallons per 1,000 feet of gas; and samples of the gas showed 22-candle power, tested with Sugg rated argand burner and Goodwin photometer.

This rate of gas making was kept up during the day time of three days.

On January 26, we began to make gas again, and continued until February 16; and it was during this time that we experienced the coldest weather of this generation.

On February 7th, 8th and 9th, with the thermometer at 10° to 14° below zero, we were called upon to make, in one day, 925,000 feet, and on other days, 810,000, 750,000, 438,000 and 436,000; and I may here state a sample of the result of some of these days' runs on which the machines were run to, or near, their capacity. February 8th, gas made, 925,000 feet. The averages of materials used per 1,000 feet were: Oil, 1.9 gallons; coal, 26 pounds; coke, 4½ pounds; candle power, 20. On a make of over 10,000,000 feet the averages of results per 1,000 feet were: Oil, 2.03 gallons; coal, 27.42 pounds; coke, 5.49 pounds. So much for the results as to the working of the machines. In its compact form it is possible to superheat the steam, to heat the oil, and also the blast, and it was no trouble to keep the steam dry, and to this may be attributed clean, bright fires in the generators. The oil is heated and fed by gravity, under a head of 6 to 8 pounds pressure, and the air blast is heated by passing all the air through the center portion of the machine, and the simplicity of the machine is apparent to any observer. Now, as to the future supply of natural gas, it is easily demonstrated from the experience here given that there need be no diminution of the supply. That gas can be made to supplement the natural gas supply, and be made in such quantities and at such rate as to fill up the fluctuations of daily use, and that the pressure can always be maintained, is only necessary to have the desired machinery, and to keep your eye on the weather bulletin. It is no difficult matter to heat a machine ready for business, and once ready, it goes for all it is worth until you say stop; and this is as easy as the start. Again, it is not a difficult matter to arrange a plant which shall have large capacity with limited holder capacity. We served over 50,000 feet of gas per hour with a combined holder capacity of 40,000 feet, the holder being nothing more than a governor, which allowed us to keep the pressure always the same and give good service.

It was frequently the case that as much as one-third of the gas served was artificial, and yet the homes were heated and the people pleased—just as though the gas was all natural, which is the proof of success, and that the people are only anxious to use the gas and willing to pay for the convenience. Just here let us look at the practical side of the question. For, say, 10½ to 11 months most companies have enough gas and to spare, but for the rest of the year they are short, consequently they give poor service for the short time and are afraid to take on new customers. Now, if they would manufacture enough to just tide them over this time, good service will be had at all times and the company be benefitted in more ways than one. Natural gas has a tough flame, so has the soft coal water gas; they mix so perfectly that no one can tell the difference when burning, and the heat units of soft coal water gas are nearer natural gas than any other artificial gas ordinarily manufactured. So far the combined gas is a decided success, and the course is one which all companies should adopt, who desire to extend the business of their stockholders and please their customers.

Natural gas was often very low in Louisville the past winter, the pressure being sometimes measured by ounces instead of pounds, and yet, by the aid of the artificial gas plant, an even pressure was maintained; and when it comes to making gas good, quick, cheap and reliable, that from soft coal will be found to be the best for all purposes. Now, that the gas making is over, and the the anxiety of low pressure is passed, the holders afloat, and all are happy, it would not be amiss

to look in on the gas maker, who, watching a pressure gauge with one eye, alternating between watching the holder drop and scanning the gas making pressure regulator, realizes that his holder will drop 1,000 feet per minute, and sees his holder only contains 5,000 feet of gas, and it all depends on the good working of the plant whether his patrons freeze or he be made happy, you may well envy the millionaire gas man the laurels he wears and the ease he seems to now enjoy. Yet these trials bring forth good results, enlarged plants and better equipment, and the coming generation may be able to see every place equipped with good gas making appliances, where gas can be made on literally a moment's notice, and where the supply will be practically inexhaustible; and the results obtained with machines of reasonable capacity demonstrate the fact that gas will be the fuel of the future in all localities, and that the gas to meet all the requirements of light, heat and power, the one whose manufacture will be attended with the least amount of loss of energy and whose results will be the best financially, and which will come more easily within the reach of the largest portion of the people of the country, will be a soft coal water gas.

Hints on Handling Gas Stoves.

[Read by Mr. Charles V. Newman, Peoria, Ills., at the 11th Annual Meeting of the Ohio Gas Light Association.]

Gentlemen:—Having been asked by your Secretary to furnish your Association with a paper as to my experience, etc., with gas stoves, I hardly know how to commence it, never having had occasion to write one before. However, I would rather undertake the task than to get up before you and explain my ideas, etc. Most of you are, perhaps, aware that I am of rather a bashful nature, and it might be somewhat embarrassing for me to do so. As many of you perhaps know, I have been in the gas stove and meter business for about 10 years; my first experience having been in St. Louis, where I was Manager of the Maryland Meter and Manufacturing Co., and opened up the first and only gas stove store that was ever operated in that city. Of course, in those days there were not the improvements there are at present, for since that time there have been many changes and new makes put on the market. After closing the St. Louis house, which I think was done in the fall of 1889, I accepted a position with the same firm, and travelled for them, making Chicago my headquarters. While with them I sold the "Success" and "Perfect" stoves, both on the road and at the St. Louis agency. At the latter place, however, we did not confine ourselves altogether to their stoves, notwithstanding that it was natural for us to push them ahead of all others, especially as they always gave the best of satisfaction—so much so, that the following season, after leaving St. Louis, I sold the Simmonds Hardware Co. of that city nearly three carloads; so great was their demand.

Since leaving the Maryland Company I have handled several other makes, and one I am sorry to say was a total failure through the fault of the manufacturers not following out my instructions, though having agreed to do so. The name, however, I will not mention, but it suffices to say that some of you probably are aware of it.

Now, to get down to what will probably be of more interest to you than the foregoing lines, I will state that it was on the 1st of April last that I accepted a position to take charge of the gas stove department of the Peoria Gas Light and Coke Co. of Peoria. While I have been somewhat disappointed in my sales, the increase over the year 1893 was over 100 ranges. It was a bad year all around, as many of you no doubt know. My first step was to get out a neat catalogue somewhat similar to the ones I take pleasure in sending you. I had my display of stoves in the gas office, in the rear of office proper, which is a large room, probably 30x70. Once or twice a week I gave cooking exhibitions, and always made it a point to have one on discount day, which was on the 10th of the month, but they were not attended as they should have been, except on the last day damed, when the attendance was pretty fair. I also was quite liberal in my advertising and enclose you a few slips cut out of our local papers. I, however, consider most of my success due to good hard licks and to the liberality of our Company in making a net rate for fuel purposes of 75 cents per 1,000 feet, and after all, I consider I was pretty fairly recompensed by having sold over 200 large ranges, besides quite a number of hot plates and heaters, and the dealers about 100 more ranges; there were also some twenty odd that were set up for private parties who moved to town, bringing their stoves with them, making in all a total of about 330 ranges.

We connect all ranges sold at a cost of $4 each. We might possibly have sold more, but as you all are aware, there are always some people who fear to get the worst of it in buying from a Gas Company; but as we wanted consumers, it made little difference where they bought, and those sold by dealers, though not a large quantity, were no doubt to a certain extent the result of our advertising and pushing them as we did. As soon as the rush was over I made it a point to make a house-to-house canvass, simply asking the privilege to put in a range on one or two weeks' trial. If it was satisfactory, the purchaser could buy it out and out, or on $5 monthly installments, the range remaining our property until paid for. In that way alone I placed in the neighborhood of 60 large ranges, and have not had to take any of them back. In the month of January of this year, with snow on the ground throughout the whole month, I sold in that way eleven large ranges, seven of them being with water-backs. All the ranges I sold were four hole, with the exception of about five or six, and those were three hole.

I have always made it point to buy the best. As you would perhaps like the know the kind we carry in stock, I will say that those sold last year were of the following makes: "Jewel," "Perfect," "Eclipse" and "Van Wie," made by the Chicago Gas Stove Company, and the "Peerless." The last named, however, was purchased before I took charge. This year I have made arrangement for the exclusive sale of "The Jewel," "Eclipse," "Perfect" and "Detroit Jewel," and the Chicago Manufacturing Company's line.

There are, of course, as many different opinions as regards gas stoves, as there are regarding the different processes of making gas. I have always made it a point when selling a range to go personally and show the purchaser how to run it, explaining to them where and how to bake biscuits, bread, pastry, etc.; how to roast, broil and toast; how to use the top burners with the least amount of fuel and still obtain the desired result. The outcome is their gas bills are not exorbitant, and while we, of course, like to see good consumers, we would rather have their bills in reason and have them satisfied than have large bills and continual complaints.

Our fuel consumption has increased something over 9,000,000 feet since April, 1894.

I regret that I am not able to be amongst you to answer any questions or discussions that may arise from this paper, and trust that it may be of interest as well as of some information to you.

Growth of a Gas Plant.

[Prepared by Mr. E. C. Gwyn for the 11th Annual Meeting of the Ohio Gas Light Association, and read by the Secretary in the absence of the author.]

The unwritten history of a gas plant would make a larger volume, if compiled in detail, than any yet written. It would tell of many losses and disappointments in their early existence, of prejudices and obstacles overcome, of successes and failures; but it would also tell of a slow and steady advancement with every change of the kaleidoscope.

The writer has not been connected with any gas company for the past eight years, except by that bond of brotherly love (if I am permitted to say it) which seems to bind all those together who have ever, as president, secretary, manager, superintendent or foreman, used coal tar and ammoniacal liquor as perfumes for their clothing.

Lighting by gas is of comparatively recent date, as compared with the world's history. From published records we find that only so early as 1739 a certain Dr. Clayton, of England, distilled gas from coal, calling it spirits of coal, and frequently amused his friends by burning it in imitation of a candle; but it was left, I believe, to a Mr. Murdock to first apply it for useful purpose, in lighting his store and office in Redruth, Cornwall, England, in 1792; but the attention of the general public was not drawn to the subject until about 1802, when the same gentleman displayed some illuminated devices in gas, on the occasion of some national rejoicing, and the following year the first street lighting was done in London.

It was many years after this that gas making was introduced into the United States, and we find that Philadelphia was first lighted about 1834. So that it would be possible for one now living to write a complete history of gas lighting in the United States and say that he witnessed the first.

I believe it would not be presumption on my part to say that the germ of the Springfield Gas Light and Coke Company was brought here in my father's brain in the year 1849, not with the view of being a public benefactor in a philanthropic spirit, but with the eye of a contractor, to enthuse the citizens with the desire for gas light and induce capitalists to invest their money in the enterprise, that he might build the plant for them.

Succeeding in this, a charter was granted and contracts made, and we

find on record that the works were ready for operation February 25, 1850—a full-fledged grease gas plant, at a contract cost of $4,450, $2,000 of which was undoubtedly intended as profit to the contractor, since he agreed to take that amount of stock in payment. (Not very valuable profit, either.)

This plant was built on the part of the lot now occupied by the north end of this Arcade building. It was built, I have been told, behind a tight board fence, 10 feet or more high, in practical secrecy from the general public. The holder was of zinc, soldered together sheet by sheet. Much of the house piping was of lead, and all small fittings were either brass or lead, no small cast or malleable fittings being obtainable at reasonable prices at that date.

At the end of the first year's operation of these works there were 9 street lamps and 15 private consumers. At the end of 18 months the works were destroyed by fire, but afterwards rebuilt and operated for a few months by the City Council, under lease, and later, in July, 1852, were leased to James D. Foster, who changed it from a grease to a coal gas works.

An anecdote is told which happened during the time the works was operated by my father and the gas made from grease. To reduce expenses (which, by-the-way, seems always to have been the watchword, no matter how ill directed), rank butter, strong lard and spoiled meat were collected at every opportunity for gas making; and on one occasion a trusty employee, born of the Emerald Isle (and, I believe, rather "lately born" from there, too), went to carry up out of a grocer's cellar, and deposit on the sidewalk ready for the wagon, a lot of cured pork which had evidently been left to get sick. He performed his task faithfully and went for the wagon. While away a practical joker carried the meat back into the cellar, so that our friend found it missing when he came back with the wagon. After some delay he found the meat in its original place in the cellar, and, hastening back to the works, with much excitement, reported that the maggots had carried it back to the cellar; and he would not be confronted with any other solution of the mystery.

From July, 1852, to August, 1857, the business was continued evidently with poor financial returns. The lease having changed from hand to hand, coming at this time into the hands of Mr. John Kinsman, of Salem, Mass., who also became by purchase one of the principal owners of the stock. He placed his brother, Mr. Nathaniel Kinsman, in charge as Superintendent, which, in those days, meant that he would have the privilege of working 24 hours a day if he could stand it, as a perquisite to the office—all at the same price.

The indefatigable efforts, incessant labors, strict economy and fair dealing of "Uncle Nat," as he was known by all, won for the Company success and placed the heretofore doubtful stock at least at par, if not a premium.

In November, 1871, a new 6-inch plant was completed on the present site and the old plant abandoned.

On May 18, 1881, Mr. A. S. Bushnell was elected President of the Company, and shortly after this he and his associates purchased the entire interest of Mr. John Kinsman, and from that time forward the business has been conducted directly by the Company—Kinsman & Company's last lease expiring in July, 1881.

With the advent of the present management began the substantial improvement of the plant. The 6-inch works were enlarged to 10 inch, and improvements in the way of larger main, etc., have been made, until the capacity of the plant has obtained a possible 350,000 cubic feet per day.

The ever progressive forethought of President Bushnell soon saw the advantage of the policy tending to cheap gas, and it was not long after his election until the price was reduced, from $2 per 1,000 to $1.75, and later to $1.50, which latter price is now charged—the reduction in street lighting being equally in proportion.

Mr. Nathaniel Kinsman continued to act as Superintendent, until March 29, 1890, when he resigned on account of ill-health, ending a term of 33 consecutive years as Superintendent. Mr. Kinsman only lived a few weeks after his resignation—peacefully passing away on the 8th of June following. In the death of "Uncle Nat" the Company lost a faithful officer, his family a true and loving husband and father, this Association a genial member, and I, the warmest friend I ever had. May we all emulate his noble character.

Mr. J. W. R. Cline, who had, since 1874, held different responsible positions in the Company's employ, was appointed Superintendent on the resignation of Mr. Kinsman.

One remarkable coincident in the history of this Company is that Mr. James S. Goode was the first and only Secretary of the Company, serving from his first election—September 19, 1891, being his last official signature on the minute book. On May 19, 1892, Mr. J. W. R. Cline was elected Secretary to succeed Mr. Goode. Having already been advanced to General Manager, his increased responsibility gave him new interests; so that, with his good health, unlimited energy, long experience and push, he has not only kept up the good work, but has extended and improved it, until to-day, the plant comprises a model works—about 40 miles of street mains, 836 street lamps and 1,520 private consumers, with a yearly output of 53,000,000 cubic feet of gas.

The inroads of electricity and natural gas, while seriously affecting the output, have not been able to cut down the dividends, so I am told; but careful and economical management, together with improved methods, have made up all losses.

So that, through many ups and downs, the Springfield Gas Light and Coke Company has arrived at a point where it is a source of fair profit and a pride to its owners. May its shadow never grow less.

It has been said in rhyme, and sentiment the same,
That large gas plants from small beginnings came;
And even so
That fair dividends from losses grow;
But dare we say that all has come about
Without hard work, sore trials, and perhaps an aching heart.

Carbide of Calcium.

[Read by Mr. W. W. Goodwin, Philadelphia, Pa., at the 11th Annual Meeting of the Ohio Gas Light Association.]

Gentlemen: At the commencement of the paper I desire to make a personal allusion. While in the enjoyment of apparent physical health, but laboring under considerable nervous strain, I was suddenly stricken down with paralysis. I am happy to say, however, that I am able to get about moderately well.

I think I can make the claim of having been one of the first gas men to examine the gas which will be the subject of this paper, and to have been the first witness of the successful burning of the pure gas in a flat-flame burner in this country or anywhere else. When I first beheld the burning in this way I thought I would have another attack; I am happy to say, however, that I have quite recovered from that shock. With these preliminary remarks, I will enter upon the subject I have in hand.

Much attention of late has been attracted by the announcement that a discovery had been made by which acetylene could be cheaply produced from a compound known as carbide of calcium, and considerable discussion has taken place among the gas fraternity, and interest manifested, as demonstrated by the fact that another paper has been read before this Association to-day upon the same subject.

As to the outcome of this startling discovery, or what its effect may be upon the gas industry of the country and world, is a question to be solved by future experience. Having been early called to look into the subject, it occurred to me I might be able to say something to the members of this Association that would be of interest to them as well as to some of my fellow gas men. With that idea in view, I have consented to address you; and, in order that my relation to the matter, and *how* I became interested in the subject, will be understood, I shall ask your indulgence and permission to deal in a little history as a preliminary.

During the early months of last year a gentleman who called on our agent in New York City stated that he was desirous of having a meter, or some form of apparatus, made which would enable him to mix and measure a given per cent. of atmospheric air with a gas that he found he was enabled to manufacture from a new composition that he discovered he was able to produce by a combination of carbon and lime in an electric furnace. This gentleman was Mr. Thomas L. Willson, the patentee of a furnace designed for the electric reduction of refractory metallic compounds. The language of the patent is: "This invention relates to the reduction of aluminum and other difficult reducible metals from refractory ores or compounds thereof by means of electric smelting." And, through the experiments made by this furnace, Mr. Willson has been able to present to us a means of producing the substance we have under consideration, known as carbide of calcium, which may possiby have an influence upon the gas business not realized or dreamed of at this time.

At the interview referred to our agent did not fully grasp the subject, having had so many calls and requests for apparatus to be made for impossibilities from those who claimed to have discovered some new system to improve the illuminating quality of gas by the mixture of air. The story, as he repeated it to me one day when at the office,

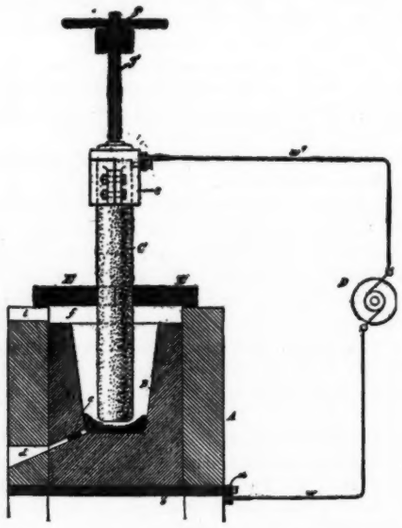
seemed so incredible that I treated it as the emanation of another crank, and so paid no special attention to the matter.

Sometime thereafter we received an order from a reliable party requesting us to make an arrangement or combination of two meters, one to measure air the other gas. We were afterwards advised the arrangement would not work with satisfaction, and the request came to me that I would pay the party a personal visit when in New York. I replied that, owing to my physical condition, I seldon visited that city; he then made an engagement to call on me at Philadelphia. At the interview he made such startling statements that I finally concluded to visit his office in new York. On doing so, I was taken to a room where I was shown the crudest form of apparatus, consisting of a small cast iron tank containing a tin gasholder, with a capacity of probably one-third of a cubic foot; there were also several small cylinders made of gas pipe of 2 and 4 inches in diameter, and from a foot to probably 18 or 20 inches in length. These were connected together and to the holder by rubber hose, thence to a short piece of pipe, on which had been inserted three or four burner cocks, mounted with burners. The gentleman, after explaining what he was about to do, placed in a small tin scoop some pieces of material that looked as though they were the fragments of some broken cobble stones. By means of a funnel attached to this piece of apparatus, water was poured and allowed to trickle through a pipe and thence on to the material in the scoop; immediately the holder began to show signs of rising. When about half way out of the water a light was applied to the burners, a brilliant flame burst forth, which was so bright that it soon became unpleasant to look at it continuously. In a few moments, after the burners had been lighted, dense volumes of carbon began to fall to such an extent that it became unpleasant to remain in the room, as both person and objects were rapidly becoming covered with the carbon so deposited. The gentleman explained this was the difficulty that himself and the patentee labored under, and it was this that they desired to overcome, and for this purpose he solicited my assistance. At a subsequent visit a smaller burner which he had just secured was then tested. The result was a decided improvement on the first exhibition and somewhat startling in its effect. I was assured that this was the first successful test that had ever been made by which the gas had been successfully burned pure without smoking, by the use of the flat flame burner, and that I was the first witness, outside the gentleman present, who had ever seen the gas so burned. It is needless for me to say that I was surprised and that I agreed to try my hand in the direction requested.

I endeavored to learn something as to where and how the material was made, its cost, and the intentions of the patentee and the gentleman referred to, who stated that he had secured the control of the patent, the process or whatever there was in the discovery; but a certain air of mystery seemed to surround the subject and was so continued that I made but poor headway in that direction. He asked me to endeavor to determine its candle power and analyze the gas, if possible. I proceeded to have a mixing apparatus made, and while it was being constructed had a conversation with a gentleman in the same line of business as myself, from whom I learned that he, too, was manufacturing some apparatus for a party, and for the same purpose, to enable them to make a similar exhibition. I visited the room where he stated the party was located, and there met Mr. Willson, who exhibited the light to me. I was naturally surprised and explained the reason of my visit, as I desired to learn if he succeeded in securing the form of apparatus that would meet their requirements, stating briefly what I had been doing for his partner in the matter.

On my return to the office of Mr. W. C. Clark, Treas. of the Gilbert & Barker Manufacturing Company of New York—the gentleman referred to and for whom I was making the apparatus—I informed him of what I had seen, and he requested me to continue my efforts. Just about this time I was compelled to discontinue my work in the matter, having been suddenly called to visit Europe on some important business. On my return, last December, I resumed my efforts, and had just reached a point where I was enabled to produce a good result by a mixture of air and gas, each of which was delivered by suitable arrangement and mixed at a point just before reaching the burner under about 1.1 inch water pressure. The light thus obtained exceeded that from any burner I had ever seen; and I have had opportunity of examining a good many different kinds, both in this country and in Europe. While I secured this result, I was not satisfied as to the safety of the arrangement, being fearful that I was too near the *danger line*, for the the gas is *very* explosive by the addition of a small per cent. of air *over* a given amount, as I hope to be able to demonstrate to you in a few minutes. I arrived at this stage of operations the latter part of January, when I was greatly surprised to learn, through the *Scientific American* and the American Gas Light Journal, that Prof. Vivian B. Lewes, of London, had read a paper on the subject before the Society of Arts, of that city, on January 16th. I have the honor of the Professor's acquaintance, having had some business relations with him and enjoyed the hospitality of his elegant home at Greenwich. The Professor is one of the ablest chemists in England or Europe, holds the Chair of Professor of Chemistry of the Royal Naval College, at Greenwich, and is also Chief Gas Examiner of the London authorities, therefore dependence may safely be placed upon whatever he may say upon this or other kindred subjects. I shall, therefore, take occasion to refer to some of the facts contained in his paper. Having given you this history of my relations to the subject, and possibly trespassed upon your good nature, I will take up a branch of the subject that may reward you in some small degree for your patience.

As explained to me by Mr. Willson's partner in the matter already referred to, the discovery of the ability of the electric furnace, patented by Mr. Willson to produce carbide of calcium, was accidental. The patentee has been engaged in experiments in endeavoring to arrive at the solution of the best form of constructing an electric furnace for the purpose already mentioned. During some of his experiments he had occasion to introduce into a carbon crucible of peculiar form and construction, along with the substance endeavoring to have acted upon through the electric current, some finely powdered carbon and lime. In the crucible was introduced a carbon pencil or electrode—the carbon retort acting as the other one. The pencil was connected with the negative pole of a suitable dynamo, and the positive pole through a suitable arrangement to the bottom of the crucible. The result was to compel the current to pass up through the mixture to the negative pole or carbon pencil. It was after one of these experiments with this furnace, in his efforts to reduce aluminum, in which this mixture had been placed, he found a substance unlike that which he hoped for, and afterwards, by design or accident, threw some of the substance found in the bottom of the crucible into some water. Instantly there was a violent ebullition, which he knew was caused by the generation of gas. A light was applied, and the result was that the gas so generated burst into a flame. Then followed a series of experiments, and, believing he had made a valuable discovery, he resolved to seek the assistance of a manufacturer of gas measuring apparatus, hence his visit to our agent, and that of his friend and partner in the matter to your speaker.



I have here a sketch of the electric furnace as shown in the patent papers, and I will now, with the assistance of Mr. Doherty, endeavor to explain the workings and operations of the furnace.

I can find no better words to explain the operation that takes place in the production of the carbide than to quote the words of Professor Lewes, as used by him in his paper, who says: "The two methods most used in chemical science for tracing the changes taking place in matter, and determining the composition of bodies, are (firstly), the breaking up of compounds into their ultimate constituents, a process which is called 'analysis;' and (secondly), the building up of the compound from the elementary matter which forms it, a process to which the name of 'synthesis' has been given." He further says: "If we take chalk and heat it in the lime kiln, or in the chemist's crucible, a heavy, colorless gas, called carbon dioxide, escapes from it, and leaves behind a sub-

stance which we know as quicklime. If now, this quicklime is further acted upon by chemical methods, it can be shown to contain the metal calcium and the elementary gas oxygen, whilst the carbon dioxide when collected can be decomposed into the elements carbon and oxygen, and by such a series of operations as this we might perform the analysis of chalk. If now, we start with the metal calcium, with carbon and with oxygen, it is perfectly simple to reverse the operation and *rebuild* the chalk molecules from these elementary forms of matter; by burning the carbon and calcium respectively in oxygen, we obtain the quicklime and the carbon dioxide, and by burning these substances together in the presence of moisture, chalk or calcic carbonate is once more formed, and we have synthetically built up the chalk from its constituents.

"By such simple methods as these most inorganic compounds can be synthetically produced from elementary matter, but in the so-called organic chemistry it is not so easy to employ such constructive methods for the formation of compounds. Up to the end of the first quarter of this century it was supposed that organic bodies were only produced as a result of animal and vegetable life, and that their formation was due to the so-called 'vital force,' which was credited with governing all changes taking place in living organisms."

Those of you who have not read or seen Prof. Lewes' interesting paper on the subject, and would like to peruse it, will find the subject treated fully in the AMERICAN GAS LIGHT JOURNAL, of the 4th of February, the January number of Light, Heat and Power, and *Scientific American Supplement*, of February 16th.

Having given you this account of the evolution, if I may so express it, of this startling and interesting discovery of the ability of the electric furnace to produce the carbide of calcium, I will, with the assistance of Mr. Doherty and Mr. Callender, make a few experiments, and thereby endeavor to exhibit the manner of making the gas from the material and show you some of its light-giving quality and characteristics.

I have here a jar containing some lumps of the carbide. I will first take a small piece and drop it into this porcelain evaporating vessel. I will now pour a small quantity of water on it. You see that bubbles instantly begin to rise, by reason of the gas evolved. I will now apply a light, and you will see it burst into flame, producing dense volumes of carbon, owing to the want of proper means to consume it. I have here a small piece of apparatus which I designed to show that, by a properly constructed burner, and confining the gas and delivering the same to the burner through a delicate governor, it is possible to consume the gas, and in doing so to produce a most brilliant light. I have here a glass vessel designed to show how rapidly the gas is evolved, and also to show the quantity of light that can be produced from one, five or seven-thousandths part of a cubic foot of the gas consumed through a burner of similar construction to the one just exhibited. I have here a pneumatic gasholder, which will hold exactly one cubic foot of the gas, which, by means of the glass tube on the side, I can divide into a twelfth of a cubic foot, or 144 cubic inches. This, again, I can divide into quarters, or 36 cubic inches, and thereby I am enabled to conduct some interesting experiments, and measure exactly the quantity of gas consumed through the burners and the time required to do so; and I am also enabled to determine by the photometer its candle power.

I have also here a small apparatus for making the gas and confining it, and thereby show its ability to be produced under pressure. Mr. Doherty will now place in this tin scoop a weighed quantity of the carbide equal to 1,400 grains, or one-fifth of a pound; this quantity, if pure, should produce one cubic foot. He will now introduce the scoop into this cylinder, and, having the plug up tightly, will by means of this vessel allow water to flow into the apparatus and on through the carbide. Instantly gas is evolved, as will be seen by the rise of the gauge attached to the cylinder.

We have now a water pressure equal to 160 inches in height. With the assistance of Mr. Doherty and Mr. Callender I will now transfer some of this gas into the pneumatic gasholder; you see by the flowing of the water out of the holder that the gas is passing into it. I have here a glass tube divided into 100 parts, by which I am enabled to show the effect of a certain per cent. of the mixture of air with gas, and the ability of the flame to travel through this pipe or tube. This is the danger line of which you will remember I spoke. I will now try to illustrate some of its properties in this direction. I have also here an arrangement by which I can show with safety its explosive properties when over-mixed with air. Having filled the tube with a proper mixture, which consists of two-thirds of air to one-third of gas previously introduced, I will now endeavor to explode it by means of this small battery and spark coil.

I will conclude my remarks by allowing some more of the gas to pass from the generator into the holder to replace that used in my experiments and that has been absorbed by the water. I now have 1 cubic foot in the holder; I have here also four ¼-foot burners, capable of jointly consuming, say, 2 feet per hour; I will place them in position and light them, which will afford any of you an opportunity of examining them more closely should you so desire.

In these remarks so far I have refrained from touching the commercial value of the carbide as an illuminant, as I prefer to leave that portion of the subject to others, my principal object being to place on record a little history and to afford you an opportunity to witness a few experiments that I thought, in view of the prominence the subject has been given, might prove of interest to you. I will, however, in concluding these remarks, give you a few figures which may enable any of you who are in an arithmetical frame of mind to do a little figuring. If the carbide is pure, 11,000 cubic feet of acetylene should be produced per ton.

1.4 grains will produce..... $\frac{1}{1000}$ of a cubic foot.
7 " " " ..... $\frac{5}{1000}$ " " "
9.8 " " " ..... $\frac{7}{1000}$ " " "

These quantities equal the graduation of my apparatus. 1,400 grains (or ⅕ of a pound) will produce 1 cubic foot; 7,000 grains (or 1 pound) will produce 5 cubic feet; 2,240 pounds (1 ton) will produce 11,200 cubic feet.

Since preparing this paper I succeeded in learning from a reliable source, while in New York last week, that the price for the carbide was placed at $100 per ton, which, on the basis of 11,000 cubic feet per ton, would equal $9.09 per 1,000 cubic feet. Making a further comparison on the basis of candle power as compared with 20-candle gas on a consumption of 5 cubic feet per hour, were it possible to consume that quantity of acetylene per hour giving 240-candle power we would have a light of 12 times the intensity of 20-candle gas, which would be equivalent to 75 cents per 1,000 cubic feet of acetylene gas of 20-candle power. I was also informed by the same party that the proposition was to place the carbide at $50 per ton which would be equal to 37½ cents per 1,000 cubic feet. A few days ago an article appeared in the New York papers, and has since been extensively published in the papers of the country, that the gas would soon be furnished to consumers at the rate of 7 cents per 1,000, which would necessitate the carbide to be furnished at about $9.30 per ton. As late as last Saturday when in New York I was informed the carbide could not be had at any price.

Any of you desiring to examine the patent papers can do so by writing to the Department, inclosing 20 cents, and asking for copies of the patents granted to Thomas L. Willson for "Process of Electrically Reducing Aluminum and Forming Alloys thereof," dated, respectively, February 7th, 1893, No. 491,394, and February 21st, 1893, No. 492,377.

This, gentlemen, concludes my subject, and I thank you for the courtesy extended to me.

The Candle Power of Arc Lamps.

Engineering News, in editorial comment on this subject, says: A great deal of friction between electric lighting companies and the municipal authorities in charge of street lighting has been caused by disputes over the candle power of arc lamps. From the beginning of the electric lighting industry down to the present time, arc lamps have been rated by their "nominal" candle power, and this "nominal" candle power has been almost invariably a much greater than the actual candle power given in service. Photometry, however, is a little known art, and was much less known when the arc lamp was first put on the market than at the present day. The brilliancy of the electric arc was so much beyond that of any previous source of artificial light that the general public, and even those in charge of local electric lighting plants, accepted these ratings in good faith, and contracts for street lighting were made based on these ratings, both parties supposing that a 1,000 candle power lamp gave 1,000 candle power as regularly as the dynamo spun around at the station.

It was not long, however, before complaints began to be rife concerning the amount of light given by the lamps both indoors and outdoors. These were due in the first place not alone to a lack of actual knowledge as to what the lamps really were doing, but also to a highly exaggerated notion of the area which a lamp of 1,000 or 2,000 candle power really should illuminate satisfactorily. That the intensity of light varies as the square of the distance from its source is a physical fact which every intelligent man is supposed to know; but it is one thing to know an abstract fact and quite another to so appreciate its importance as to make practical use of it in daily life.

The complaints of the storekeepers who had expected a single arc lamp rated at 1,000 candle power to give several times the illumination of a dozen or twenty gas lamps, and of the street lighting committees who had located arc lamps too far apart, finally resulted in some actual photometric tests, the result of which was about equally surprising to the electric lighting men and the purchasers of light. In the first place, it was found that the actual candle power of an arc lamp was far less than its rated candle power. In the second place, it was found that the measurement of arc lamp candle power was difficult to accomplish with any approach to accuracy, and this was especially the case if the candle power was required to be measured with the lamp in position in the street. In the third place, the fact was developed that light radiated from an arc lamp is very unequally distributed. According to diagrams published in our issue of Dec. 19, 1891, if the candle power given off in a horizontal plane by an arc be taken as 200 candle power, then that directed downward in a line making an angle of 20° with the horizontal may be 400 to 700 candle power, and the maximum of 650 to 1,050 candle power is attained at an inclination of between 35° and 50°. At 60° the light falls of to some 300 to 700 candle power. This is the actual light emitted by a lamp consuming about 405 watts of electrical energy per hour, or about the size of lamp that has been ordinarily rated at 2,000 candle power.

Under all these circumstances the absurdity of contracting to furnish street lights of a certain candle power, without specifying when and how the candle powers to be measured, is manifest. At the convention of the National Electric Lighting Association in 1894 a committee recommended that instead of rating arc lamps by candle power, they should be rated by the electrical energy consumed, and that a 2,000-candle power lamp should be one absorbing 450 watts per hour.

But at the convention of the Association just held at Cleveland, Mr. L. B. Marks read a paper on "Arc Carbons and the Rating of Arc Lamps," in which he showed conclusively that the amount of light given out by the same lamp, taking the same amount of electric energy, varies as much as 25 to 40 per cent., according to the quality of the carbons used. The same law seems to hold good here as in the incandescent lamp, that is, the carbons which give least light per unit of energy expended last longest, and those which give the highest efficiency, that is, the greatest amount of light in proportion to the electric energy expended, burn away most rapidly. When we consider the fact that an arc lamp carbon becomes luminous by the vaporization of the carbon under the intense heat, the reason is apparent why the soft carbons, which burn away most rapidly, give the best light.

Besides the mechanical density, the composition and form of the carbon have much to do with the efficiency of the lamp. It has been very generally supposed, both by electric lighting managers and carbon manufacturers, that an absolutely pure petroleum coke carbon would give better results than any other. Tests by Prof. Marks, however, showed that carbons made with special reference to secure absolute purity gave less satisfactory results than ordinary commercial carbons. These very pure carbons began to hiss at a potential of 53 volts, corresponding to a consumption of energy of 503 watts, whereas ordinary commercial carbons did not hiss till the potential fell to 41 to 51 volts, corresponding to 390 to 485 watts.

Again, cored carbons have come largely into use, especially for indoor service, as they do not hiss until the potential falls to some 31 to 35 volts. Tests show, however, that such carbons, while giving a very steady light, gives less light by 15 to 20 per cent. for a given consumption of energy than a solid carbon. With alternating current arcs this rule is reversed, and the solid carbon gives less light with the same consumption of energy than the cored carbon. It is also found that on the whole the direct current arc lamp gives more light per unit of energy expended than the alternating lamp.

A German scientist has propounded the law that with a given current the candle power of an arc varies inversely with the square of the diameter of the carbon. In other words, the emission of light increases rapidly with increase in the amount of electricity forced through a unit area of cross section of the carbon. Of course, this law is true only in a roughly approximate way.

Prof. Marks also stated in the paper above referred to that the candle power of a lamp is influenced materially by variations in the character and size of grain of the pulverized crude material, in the nature of the binders, the consistency of the mixture when finished, in the pressure at which the carbon is molded or squirted, in the duration of carbonization and the temperature at which it is performed. Finally, the quality of of the light varies materially with the current used. Arc lamps on incandescent, or constant potential circuits, produce more yellow rays, whereas, with the ordinary constant current arc lamp, the rays at the other end of the spectrum predominate, giving the light its distinctively violet tinge.

In view of all these facts, the question arises, on what basis should a contract for street lighting by arc lamps be made? The old basis of contracting for so many street lamps of so many nominal candle power each is absolutely meaningless. On the other hand, if a city contracts for street lamps, each consuming 450 watts of energy, it may get good light or poor light, according to the kind of carbons used. In fact, there will be a certain tendency for the electric lighting company to try to increase its profits by using hard carbons of low efficiency, which will burn away slowly, rather than soft, rapid-burning carbons of high efficiency. It may be said that the electric lighting company will endeavor to give the most light possible from the given current consumption in order to give satisfactory service; and this may be true where street lighting contracts run for only one year. But it is generally admitted that these short-term contracts for public lighting are poor policy for the public, as well as for the contractor. Low prices for street lighting, combined with efficient service, can never be expected if the contractor has no security that the plant he installs will be in use longer than a twelvemonth. What is wanted is some definite basis of agreement under which a city can contract for lighting for a 5-year or 10-year term, with full assurance that it can at any time determine whether it is receiving all it has agreed to pay for.

In the light of present knowledge it would seem that no contract which merely specifies the number of watts a lamp shall consume, nor states it to be of so many nominal candle power, is likely to give satisfaction. If the lamp is to be rated by watts, then some provision should be inserted in the contract requiring the electric lighting company to furnish carbons which will convert the energy into light with reasonable high efficiency.

But there are many indications that no rating of street lamps on any other basis than candle power is likely to come into general use. What is actually purchased is light, not electric current. The lighting company provides and maintains the apparatus for converting the current into light, and is entitled to credit for doing this with efficiency. If a town or city were to establish its own lamp posts and lamps, and furnish its own carbons, it would then be entirely proper to purchase current supply of a given amount at a given rate per lamp. This practice, however, has never been adopted, save possibly in isolated cases.

A still more potent reason why the candle power rating is likely to be adhered to is that it is a basis which the non-technical man can understand. The city authorities who contract for street lighting will require the contract to be put in terms within their comprehension.

The proposition has been made in this connection that instead of measuring the intensity of the sources of light, contracts might be made to specify the amount of illumination. A valuable paper, read before the Institution of Civil Engineers, October, 1892, described the measurement of illumination and a convenient portable photometer for effecting such measurements. This subject has been recently brought up again by a paper read at the Cleveland meeting of the Electric Light Association by Messrs. Houston and Kennelly, in which the authors advocated the measurement of illumination and described an instrument which they had invented for that purpose. In this paper the plan was advocated of basing contracts for street lighting upon the illumination furnished rather than the intensity of the sources of light. It seems very doubtful, however, whether such a basis for lighting contracts is likely to find favor. The illumination along a city street, for example, is greatly influenced by the character of the buildings along it, and the relative reflection and absorption of light from their walls. Unless a lighting company had entire control over the spacing and location of the lamps, it could hardly venture to enter into such a contract.

On the whole, therefore, the reform that seems most desirable, with our present knowledge, is a reform in the rating of lamp candle power. A contract for street lighting should specify that each arc lamp shall consume so many watts, and shall have an intensity of at least so many actual candle power in a direction making an angle of say 35° with the horizon. This candle power should be that which the lamp is capable of actually showing under test when supplied with carbons of reasonably high efficiency, and not the meaningless candle power rating of the manufacturers.

The parties to such a contract should fully understand that the candle power of an arc lamp is subject to more or less variation, and that it cannot be measured with the exactness that weight or length can be determined. On the other hand, it can be measured with accuracy sufficient to determine whether the city is getting what it pays for in illumination, and to check any effort of the contractor to economize at the expense of the quality of service, and this is, after all, the purpose of all such contract requirements.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

It is with no little satisfaction that we announce a business-like settlement of the promised opposition contest at Freeport, Ills. Briefly stated the position there is this: Some weeks ago a charter was issued for the Freeport Light and Fuel Company, and the capitalists behind it were ready to go on with the construction of a gas plant, for there is little doubt that the authorities would have granted the opposition a local franchise. Rather than precipitate a conflict, Mr. L. Z. Farwell, the virtual proprietor of the Freeport Gas Light and Coke Company, opened negotiations with the projectors of the new Company, which finally culminated in the purchase by the latter of Mr. Farwell's holdings. The formal transfer will be made to-day, and the new concern will be under the management of Mr. Z. T. F. Runner, whose administration of the affairs of the old Company was such as to cause him to be decidedly popular with the residents of Freeport. A round sum will be expended this season in improvements on the manufacturing and distributing systems. Mr. Roy K. Farwell retains an interest in the Company.

The loss occasioned by the recent fire at the La Crosse (Wis.) Gas Light Company's works was greatly overstated, the damage amounting to $300, instead of the $2,500 reported. The structure destroyed was the coke shed. We congratulate Manager Rodgers on the case as it is; and we would be still better pleased if we could have said that the damage was $3 instead of $300.

The following explains itself: E. P. Gleason Mfg. Co., New York, March 13, 1895.

Welsbach Light Company, Gloucester City, N. J.—Gentlemen—Yours of the 12th inst. received. You may deny in print, most emphatically, that any such conversation, as published in *Electricity* some months ago, took place between any of our officers or employees and a representative of the paper as stated. When we noticed the article in question we immediately sent a denial to the Editor, which he, however, failed to publish. Yours respectfully, E. P. Gleason Mfg. Co., E. P. Gleason, Pres. (E.F.G.)

An esteemed correspondent at Belleville, Ills., forwards the following: "Mr. Phillips J. Green, a banker of New Orleans, La., representing himself to be a millionaire, was in Belleville some weeks ago organizing a second gas company with a capital stock of $150,000. In fact he managed to have an ordinance regulating its operation for 50 years passed to a third reading by the Council. The Belleville Gas Light and Coke Company has existed here for 40 years, and it has the best adapted and equipped coal gas plant in Southern Illinois, with a capacity of 40 millions cubic feet. Its output is about 14 millions cubic feet per annum, and has been declining within the last two years. The selling price of gas is $1 per 1,000 cubic feet to all customers averaging 5,000 cubic feet per month. Mr. Green's associate is Mr. C. W. Ketcham, a broker of Chicago, who is reported to be a representative of the Rew soft coal process people of his city. Mr. P. J. Green and the citizens of Belleville will probably rue the day on which the scheme will be consummated. The intelligent citizens of Belleville are amazed at the honor conferred upon them, and are also astonished that money is so plenty at the Crescent City, of Louisiana."

We made mention last week of the standing of these men named by our Belleville correspondent, and imagine that less will be heard of them in the gas business in the future than has been heard of them in the past. Meanwhile we are sorely tempted to publish reports on the actual business standing of Green and Ketcham, which reports were prepared respectively by a mercantile agency of world-wide renown and an equally celebrated detective agency. We believe, too, it is absolutely accurate to say that Ketcham in no sense has any connection with the proprietors of the Rew gas making process.

The betterments on the plant of the Oskaloosa (Iowa) Gas Company are to all intents and purposes completed. The manufacturing plant, which is of the improved Lowe pattern, is up to a daily output of 150,000 cubic feet.

A concerted movement by the Illinois Gas Companies is underway to oppose the following bills now before the Legislature of that State. The first was introduced by Mr. Revell, in the House, on March 12th, and was referred to the Committee on Municipal Corporations. In substance it is a bill to compel gas companies to supply prepayment meters:

"Section 1. Be it enacted by the people of the State of Illinois, represented in the General Assembly: Any person or corporation manufacturing or selling illuminating gas to private consumers shall, on demand of his or its consumers, place, with all connections for its use, where said consumer may direct, in a reasonable and convenient place of access, furnish, free of charge, a prepayment meter. If any person or corporation aforesaid shall violate the provisions of this section, he shall, for every such offense, forfeit and pay to the person aggrieved $200; said sum to be recovered by action of debt in any court of competent jurisdiction."

The second bill, which was introduced in the House by Mr. Schubert (No. 566), is also a bill in relation to gas meters, and which was also referred to the Committee on Municipal Corporations, is as follows:

"Section 1. Be it enacted by the people of the State of Illinois represented in General Assembly: Every person or corporation engaged in the manufacturing or selling of fuel or illuminating gas to private consumers, shall furnish, free of charge to each consumer, with all connections, the meter through which said gas is measured. If any person or corporation aforesaid shall violate the provisions of this section he shall, for every such offense, forfeit and pay to the person aggrieved $200, said sum to be recovered by action of debt in any court of competent jurisdiction."

These are two pretty fair specimens of the "striker's" art, and so it goes. Perhaps the gas men of the Sucker State will eventually elect to petition the Legislature for a Gas Commission to supervise their affairs; say, something modelled on the laws of the body which so admirably protects the best interests of the gas consumers and gas manufacturers of Massachusetts.

A correspondent at Toledo, O., forwards the following, under date of March 21st: "Anna Schmidt has commenced suit against the Toledo Gas Light and Coke Company, for damages in the sum of $15,000. The petition recites that in the fall of 1894 the defendants had occasion to disconnect the pipes by which gas was conveyed to her residence, and in so doing they carelessly and without the exercise of ordinary care, shut off the supply in a manner which allowed the gas to escape and fill the house, and in consequence of inhaling the gas she became seriously ill and will continue so for some time. She, therefore, asks for damages in the amount named. Matheas Schmidt, the husband, also files a petition against the same concern, asking for the modest sum of $3,500. Her petition recites that the entire family was poisoned by reason of the escaping gas, and asks for $500 for doctors, nurses and medicine. He was also deprived of the services and society of his wife, which were worth $1,000; and for the reason that she will become totally and permanently disabled he thinks the sum of $2,000 would be about the proper amount to reimburse him. The Company interposes a denial, and asserts that the damage occasioned the Schmidt family is the result of their own disregard of natural cause and effect."

Certain parties have applied to the authorities of Eagle Grove, Ia., for an ordinance granting a franchise to the Eagle Grove Gas Light Company. We fail to understand how an enterprise of this kind could be considered as likely to be profitable in the place named, for its population is certainly less than 2,500. It is mid-way of Fort Dodge and Clarion, on the Mason City and Fort Dodge Railroad.

The capital stock of the Ocala (Fla.) Gas Company has been doubled up. It is thought the works will be completed within three months.

Mr. J. E. Luckenbach, after faithful service for 18 years with the Bethlehem (Pa.) Gas Company as its meter inspector, tendered his resignation because of failing health. M. J. Schmid succeeds him.

The County Board of Supervisors, of Louisville, Ky., has increased the rating of the Louisville Gas Company's properties for assessment purposes in the sum of $250,000.

Under the new ordinance adopted by the authorities of Davenport, Iowa, for the regulation of gas rates, the Davenport Gas Light Company is directed not to charge in excess of $1.35 per 1,000 cubic feet for an illuminating gas supply, nor may it charge in excess of $1.25 per 1,000 cubic feet for gas used for cooking, heating and power purposes. It may, however, charge a meter rent of 25 cents per month where consumption in 30 days does not amount to 150 cubic feet. The ordinance also provides that if the Company does not comply with its provisions, it shall not be granted permits to tear up or excavate streets, etc. The Company will undoubtedly refuse to accept the schedule which, of

course, is decidedly unfair to it, and the courts will eventually determine the legality of the conditions imposed.

THE Berlin Iron Bridge Company, of East Berlin, Conn., is constructing in this city a large building for Mr. James Everard. The structure will be 120 feet square, and 12 stories high, with a steel frame. It will be entirely fireproof.

WE are in receipt of a well-compiled catalogue issued by the Davis & Farnum Manufacturing Company, of Waltham, Mass. The book, besides accurately and concisely describing the specialties for which this firm is noted, also carries brief mention of many things of interest and helpfulness to the gas engineer.

UNDER an amendment to its charter the Board of Directors of the Middletown (Conn.) Gas Light Company now consists of 7 instead of 9 members. At the annual meeting the following officers were elected: Directors, W. T. Elmer, E. H. Hubbard, W. H. Burrows, A. B. Calef, H. L. Mansfield, William Wilcox and Henry Woodward; President, A. B. Calef; Secretary and Treasurer, H. L. Mansfield.

THE Rockville (Conn.) Gas and Electric Company will extend its mains this summer, which remark reminds us that Manager Harbison, of the Hartford City Company, will also put in 4 or 5 miles of 10-inch pipe before the frosts of next winter.

THE following despatch was received by us on the 23d inst. "Phillips J. Green, banker, New Orleans, La., has been attached for rent." Rockford, Belleville and Danville, Ills., authorities please take notice.

MR. J. B. GRANT, Superintendent of the Thomasville, Ga., Gas Works, is our authority for the statement that several additions will be made to the plant, notably, new scrubbing and pumping apparatus and 2 miles of 4-inch gas mains.

AT the preliminary meeting of the superintendents of the gas, electric light and water plants of the State of Missouri, for the purpose of forming a permanent organization, the proceedings resulted in the formation of a body to be known as the Missouri Water, Gas and Electric Association. The officers for the first year are: President, W. E. Walton, of Butler; Vice-President, Jas. A. Montgomery, of Sedalia (Superintendent of the Sedalia Gas Light Company); Secretary, C. F. Strohm, of Nevada; Treasurer, R. D. Wirt, Superintendent of the Independence Gas and Coke Company. It was decided to hold the annual meetings in Sedalia, Mo., on the third Tuesday of March in each year.

THE proprietors of the newly organized Bronx Gas and Electric Company, which proposes to supply gas in that part of Westchester county, N.Y., to the east of the district of the Northern Company, of New York, and south of the city of Mount Vernon, have awarded a contract to the United Gas Improvement Company for a complete 8-inch water gas manufacturing station. The contract calls for the placing of one set of standard Lowe double superheater generating apparatus, with scrubber and condenser to match; four 8 by 8 by 4 purifiers, complete; a 6-inch station meter; a 50,000-ft. storage holder in steel tank; a 5,000-ft. relief holder in steel tank; a 12,000 gallon storage oil tank; an 8-inch Connelly governor; and all necessary auxiliary parts, such as engines, pumps, bye-passes, connections, etc. The initial capacity is to be 100,000 cubic feet each 24 hours, and it is intended that the completed works shall be a typical water gas plant of small caliber. It is understood that the works will be ready to supply gas by July 4th. The district to be supplied virtually has for its center the village of Unionport, which is a part of Westchester, and the nearest railroad station is Van Nest, on the Harlem branch of the New York, New Haven and Hartford system.

THE celerity with which the new Gas Company at Ocala, Fla., was brought along has prompted the citizens of Tampa, Fla., to do likewise, for the Tampa Gas Company has been organized and its application for a franchise is now before the City Council. It is capitalized in $150,000, and its officers are: President, Edward Manrara; Vice-President and General Manager, Albert J. Boardman (Minneapolis, Minn.); Secretary and Treasurer, Peter O. Knight.

MR. M. RUMSEY MILLER, of Bath, N. Y., who was named by the Supreme Court to sit as Referee in proceedings instituted by certain creditors to determine the solvency of the Elmira (N.Y.) Gas and Illuminating Company, has handed in his report. He finds that the Company is entirely solvent, and, as a result of the report, Justice Walter Lloyd Smith, of the Supreme Court, has ordered the Receiver (Mr. Reuben Leland) to turn the property over to its real owners.

THE 2,226 shares of the new issue of stock by the Brookline (Mass.) Gas Light Company, which were to have been sold at auction on the 20th inst., were withdrawn. The sale is to be brought off, according to latest advices, on April 17th.

MR. MERRITT GREENE, of Pittsburgh, President of the Bridgewater (natural) Gas Company, is our authority for the statement that his Company proposes to construct an artificial gas plant the coming summer, at a point between East Liverpool and Wellsville, Ohio.

IT is with great regret that we announce the retirement from the offices of Secretary and Treasurer of the Charleston (S. C.) Gas Company, of Mr. Wm. R. Morrison, whose health is such that he could no longer stand the strain. The Company owes much to him for his faithfulness and efficiency, and it will be the universal desire and hope that rest will restore him to his old-time strength and vim. His successor is Mr. Montague Triest.

THE Belvidere (Ills.) Gas Light and Fuel Company has been incorporated, with a capital stock of $50,000, by Messrs. C. B. Dean, E. S. Rowan, John L. Witbeck, W. T. Longcor, P. R. Kennedy, Irving Terwilliger and George H. Hurlburt. This place is the capital of Boone county, Ills., and is on the Kishwaukee river and the Freeport branch of the Chicago and Northwestern Railroad, at a point 78 miles northwest of Chicago and 43 miles east of Freeport. It is a brisk, lively center, and has a population not far from 7,000. A Gas Company ought to do a thriving business there.

THE following is the report made by the City Engineer of Troy, N. Y., on the matter of investigating the fair price and good quality of the gas supplied in that city by the Troy Gas Company, which matter was referred to him by a resolution of the Common Council: "Pursuant to the requirement directing the City Engineer to report as to the measurement, quality and cost value of the gas consumed by the city, I herewith submit the following statement: All bills for gas for which drafts are issued from this office are properly sworn to, and the state of the meters is carefully taken by this department and each bill checked; but this office, so far as I know, has never been provided with any apparatus for testing the quality or any means of arriving at the cost value of the gas furnished the city. I have on several occasions during the last two years called the attention of the Contracting Board to the above facts. Until the meeting of the Common Council on December 20, 1894, no authority was given to the Contracting Board for furnishing such materials, and the said Board has not as yet supplied the same. Having recently learned that the Gas Company has appliances for testing gas, I have made arrangements with the Company to use its photometer (an expensive machine for testing gas and requiring a specially prepared room for its use), and after the same is set up careful tests of the gas can be made, but until some apparatus is prepared or this one properly arranged, I have no means of testing and reporting on the quality of the gas furnished. The city has lately entered into contract with the Troy Gas Company to furnish gas to city buildings at $1.35 per 1,000 feet. I have not been able to ascertain the manufactured cost of said gas, although I have tried to do so, but said rate compares favorably with the average price obtained by Companies similarly situated in the State of Massachusetts, as per the 1893 report of the Gas and Electric Commissioners of that State. Their figures show an average charge per 1,000 cubic feet for *all* the Companies making either coal or water gas of $1.32 per 1,000.—M. R. SHERRERD."

Decomposition of Water by Iron.

Iron is said to be incapable of decomposing water at ordinary temperatures except in the presence of air or by galvanic action, when some electro negative substance is connected with it. For this reason we should expect little corrosion from rust in the interior of a boiler, as air is only periodically admitted when the boiler is cooled down. There is, however, the dissolved air of the feed, and this is reduced in amount when the feed water is previously heated. Under any circumstance the rust found in the interior of a boiler is of a different character from ordinary iron rust. It is, in the first place, of a much darker color. That formed in the upper spaces by steam alone is almost black, partaking of the nature of that black magnetic oxide which is formed in the Barff process by steam heated to 950° F. The latter oxide is, of course, completely protective when once formed, and the oxides formed in the interior of a boiler, although not of a protective nature, are, nevertheless, far less corrosive in their action than those formed under ordinary circumstances. This is another reason for supplying a pure feed water to steam boilers. The corrosion of the interior, when not assisted by adhesive deposits and organic acids from the lubricants, is comparatively slow, and the life of a boiler may be greatly prolonged by the exercise of care in this particular.

The Market for Gas Securities.

The market for city shares was lifeless during the week, and Consolidated closes nominally weaker, being offered at 132. We have no reason to change our belief that much higher figures will be made in this security before long; in fact, that it will sell at a valuation higher than any heretofore made in it. The Legislature will not change the gas rate. Mutual is steady and strong, which also explains the situation in respect of Equitable. New York and East River common was inquired after during the week, and 23½ is freely bid for it. Standard preferred is 91 bid, and the common is at 40 bid. There is no change in Brooklyn prices, and Wray's bill to prevent consolidation is slumbering. Chicago is weak, on a fairly well defined belief that the dividend rate will be cut to 5 per cent. The opening to-day (Friday) was made at 71⅜ to 71½. Bay State securities are weak, the United firsts being offered at 75½. Lacledes maintain the recent advance, and Baltimore Consolidated is sluggish, at 62½ offered. Western gas, of Milwaukee, is offered at 47½, and the 5's are worth probably 86½. Jersey City gas is 200 bid, and looks as if it might go higher.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

April 1.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	131½	132
Central	500,000	50	140	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	185	188
Bonds, 6's	1,000,000	1,000	107	..
" 1st Con. 5's	2,300,000	..	..	..
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	155	..
" Bonds	1,500,000	..	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	..	..
" Bonds	150,000	..	93	98
New York and East River	5,000,000	100	23½	24½
Preferred	2,000,000	100	42	45
Bonds	3,500,000	1,000	83¾	84½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	..	..	..
Standard	5,000,000	100	40	40½
Preferred	5,000,000	100	91	..
Bonds, 1st Mortgage, 5's	1,500,000	..	102½	105
Yonkers	.....	50	112	.
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,300,000	20	65	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	300,000	..	103	..
Peoples	1,000,000	10	90	.
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	200	..
" Ctfs	700,000	1,000	99	100
Williamsburgh	1,000,000	50	200	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	15	14¾	15
" Income Bonds	2,000,000	1,000	..	94
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	74	75½
2d " " "	3,000,000	1,000	50	52
Buffalo Mutual	750,000	100	120	..
" Bonds	200,000	1,000	95	100
Chicago Gas Co.	25,000,000	1,000	71⅛	71½
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	93	93½
Columbus	1,069,000	..	..	..
1st Mortgage	1,085,000	..	..	..
Consumers. Jersey City	2,000,000	100	72	77
" Bonds	600,000	1,000	95	100
Cincinnati G. & C. Co.	7,000,000	100	..	203¾
Consumers, Toronto	1,600,000	50	184½	187
Central, San Francisco	.....	..	90	100
Capital, Sacramento	.....	..	..	50
Consolidated, Baltimore	11,000,000	100	..	62½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	18	..
" Con. Bonds	4,312,000	..	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	82	83
" Bonds	2,000,000	..	75	78
Hartford	750,000	25	120	128
Indianapolis	2,000,000	..	145	150
" Bonds, 6's	2,650,000	..	103	..
Jersey City	750,000	20	190	200
Lafayette Gas Co., Ind	1,000,000	100	85½	87½
Bonds	1,000,000	1,000	90	..
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	26	26¾
Preferred	2,500,000	100	82	85
Bonds	9,084,400	1,000	93½	93⅝
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	208
New Haven	.....	25	200	..
Oakland, Cal.	.....	..	42⅝	43
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	167	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	81	..
Bonds, 6's	.....	..	..	..
Consolidated 5's	.....	..	..	..
Syracuse, N. Y.	500,000	25	..	..
San Francisco, Cal.	10,000,000	100	72⅝	73¾
Washington, D. C.	2,000,000	20	230	..
Western, Milwaukee	.....	100	46	47½
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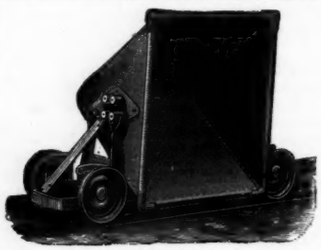

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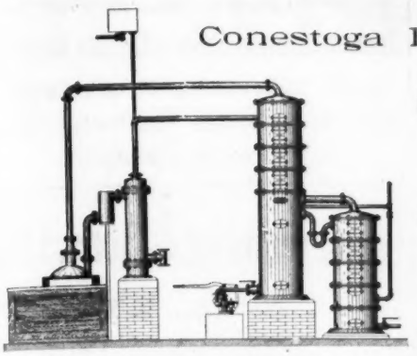

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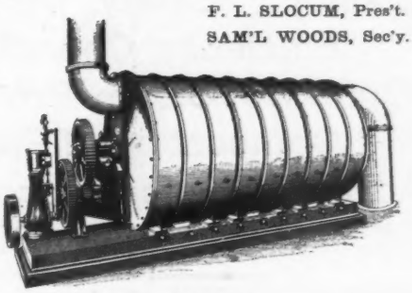

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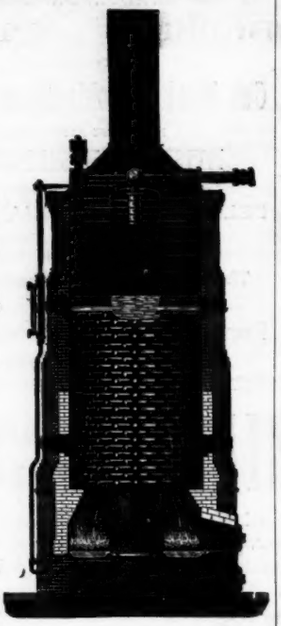

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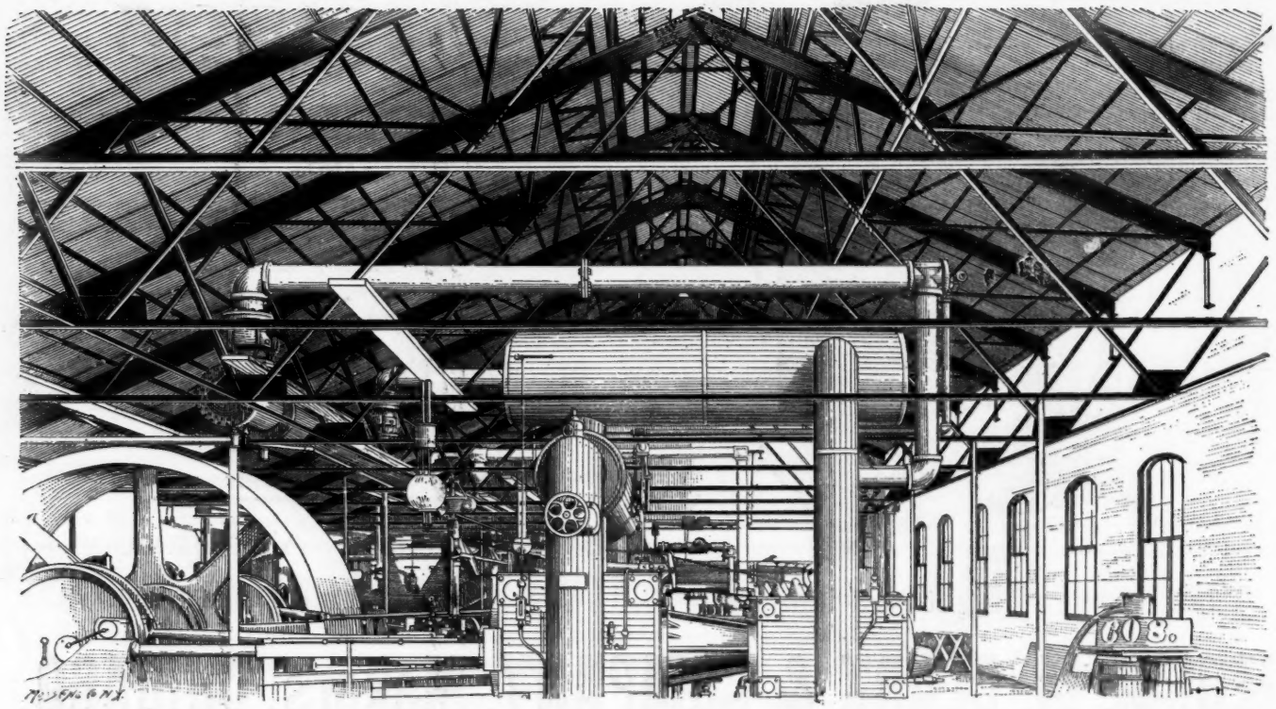

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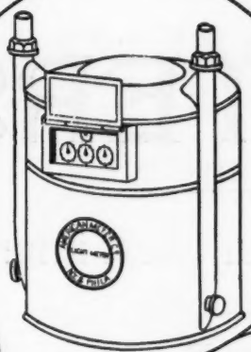
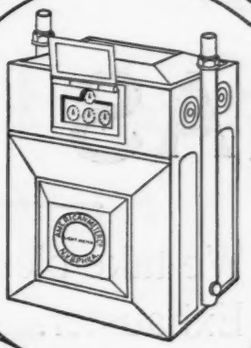
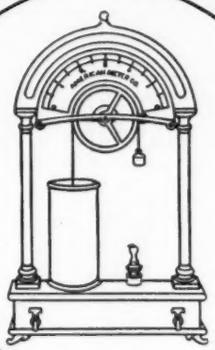


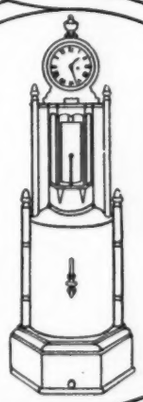


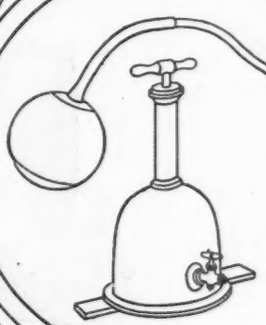


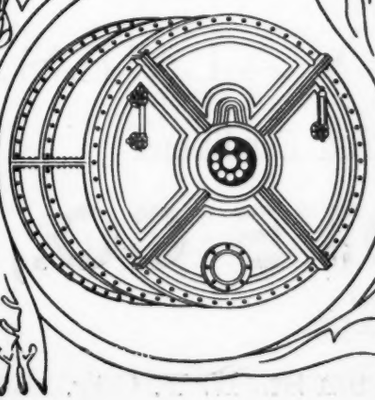
PUBLIC LIGHTING TABLE.

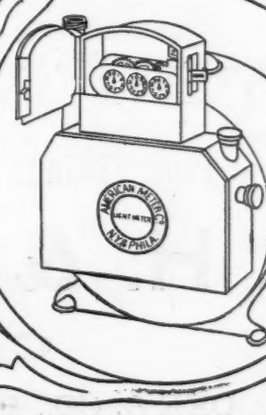
APRIL, 1895.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	12 30 AM	4.40 AM	6.10	4.55
Tue.	2	1.20 FQ	4.40	6.15	4.40
Wed.	3	2.00	4.40	6.15	4.40
Thu.	4	2.40	4.40	6.15	4.40
Fri.	5	3.00	4.40	6.15	4.40
Sat.	6	3.30	4.40	6.15	4.40
Sun.	7	4.00	4.40	6.15	4.40
Mon.	8	No L.	No L.	6.15	4.40
Tue.	9	No L. FM	No L.	6.25	4.30
Wed.	10	No L.	No L.	6.25	4.30
Thu.	11	7.00 PM	10.30 PM	6.25	4.30
Fri.	12	7.00	11.40	6.25	4.30
Sat.	13	7.00	12.40 AM	6.25	4.30
Sun.	14	7.10	1.40	6.25	4.30
Mon.	15	7.10	2.20	6.25	4.30
Tue.	16	7.10 LQ	3.00	6.30	4.20
Wed.	17	7.10	3.30	6.30	4.20
Thu.	18	7.10	4.00	6.30	4.20
Fri.	19	7.10	4.10	6.30	4.20
Sat.	20	7.10	4.10	6.30	4.20
Sun.	21	7.20	4.10	6.30	4.20
Mon.	22	7.20	4.10	6 30	4.20
Tue.	23	7.20	4.10	6.40	4.10
Wed.	24	7.20 NM	4.10	6 40	4.10
Thu.	25	7.20	4.10	6.40	4.10
Fri.	26	7.20	4.10	6.40	4.10
Sat.	27	7.20	4.10	6.40	4.10
Sun.	28	7.20	4.00	6.40	4.10
Mon.	29	11.10	4.00	6.40	4.10
Tue.	30	12.00	4.00	6.45	4.00









TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146 30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45

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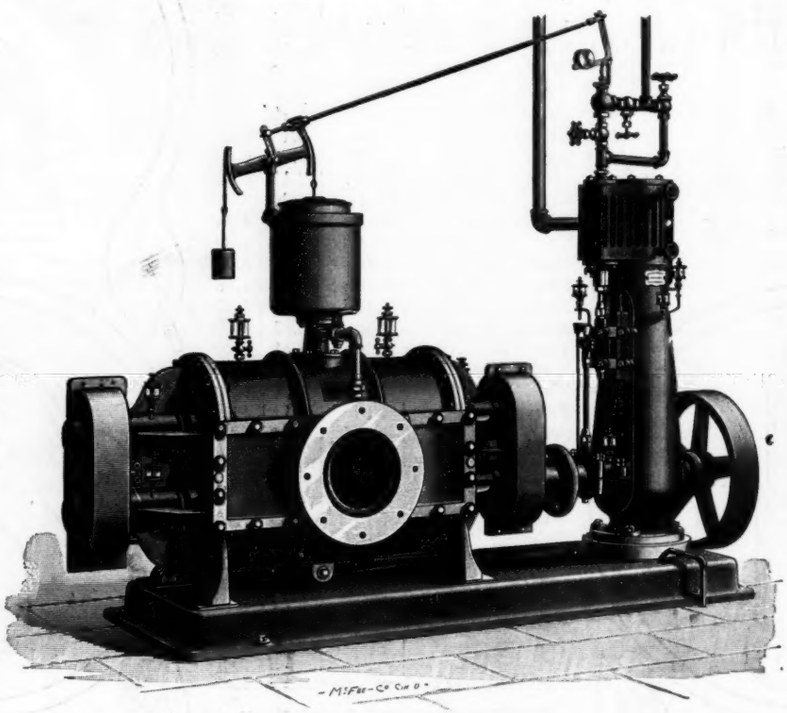

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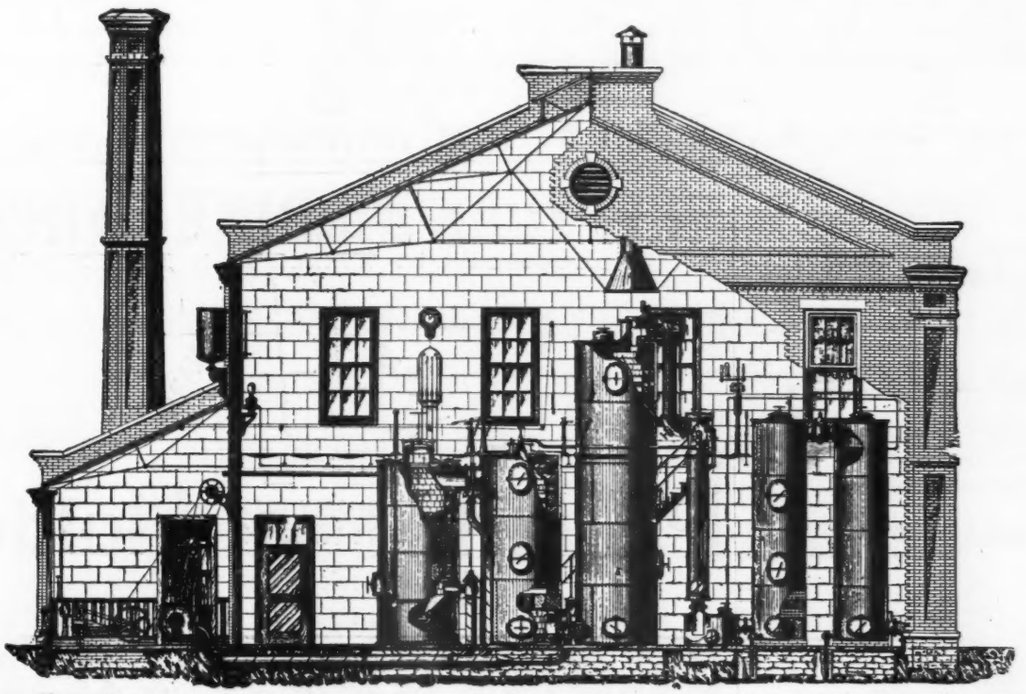

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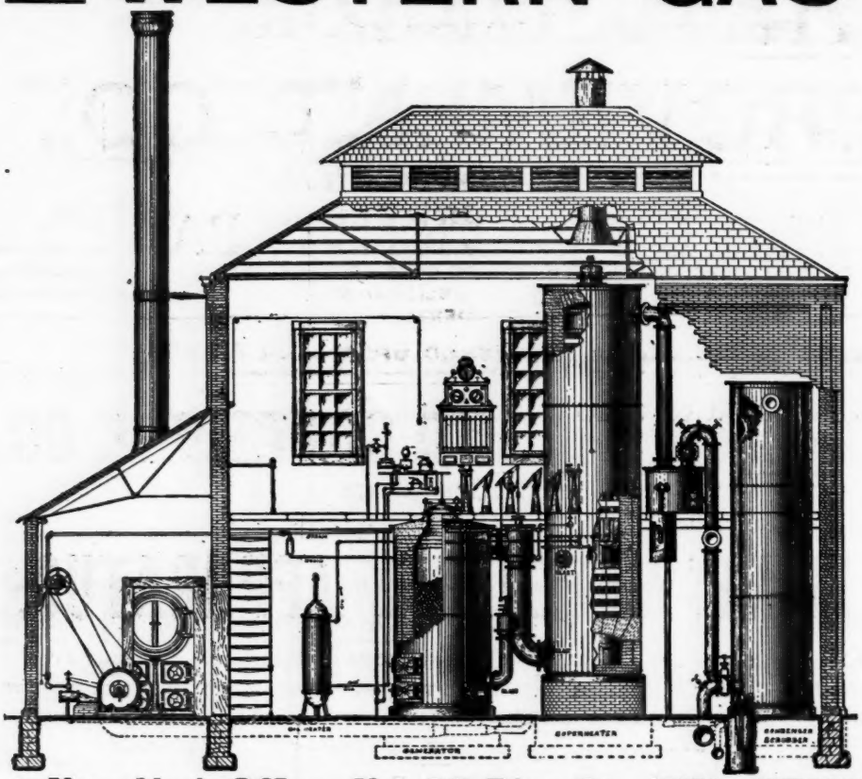

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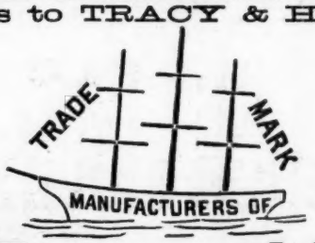

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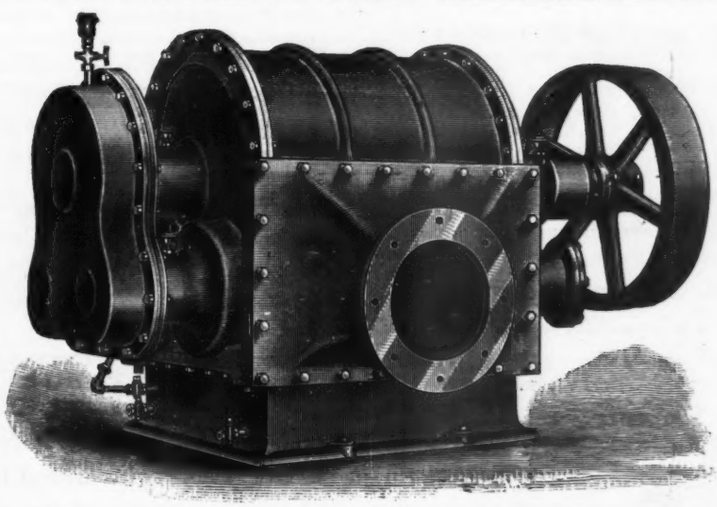

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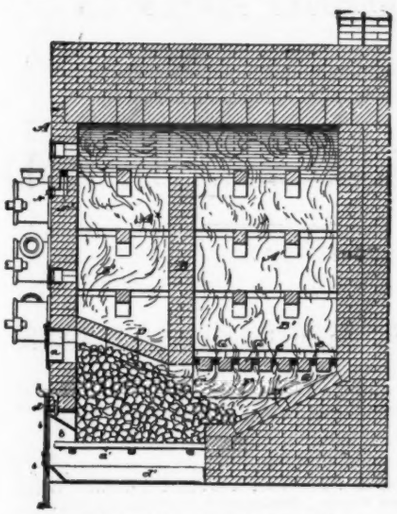

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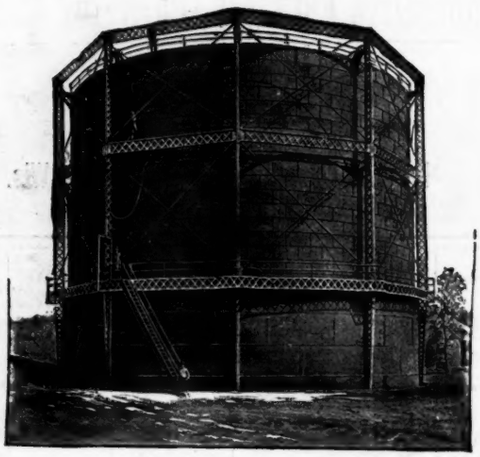

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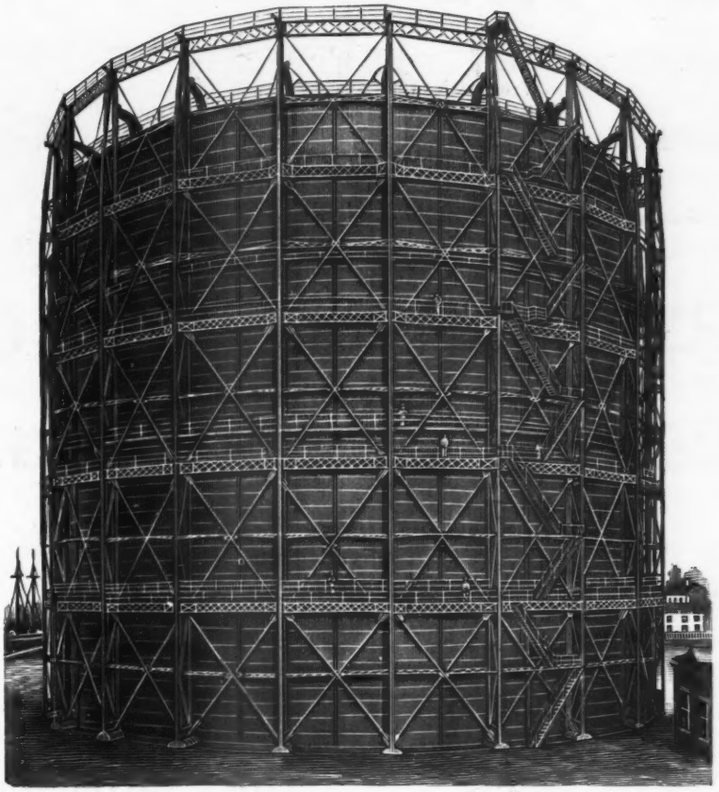

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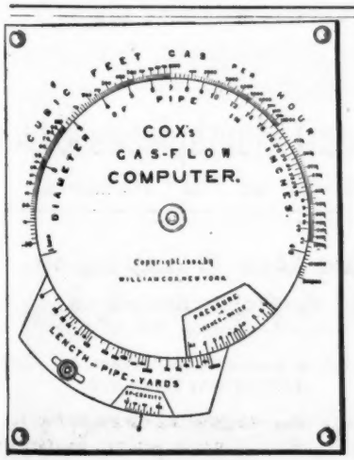

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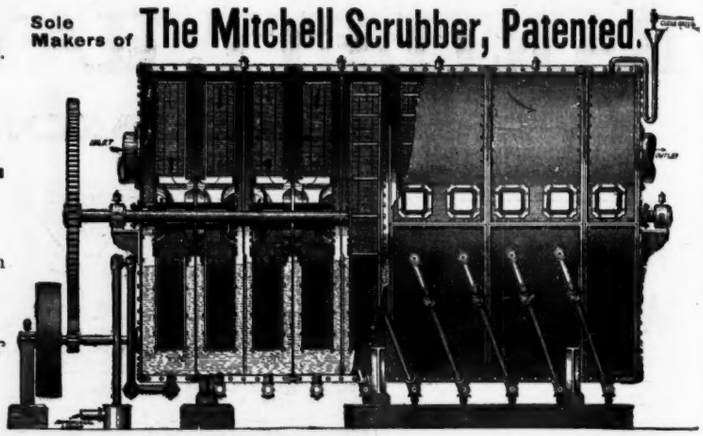

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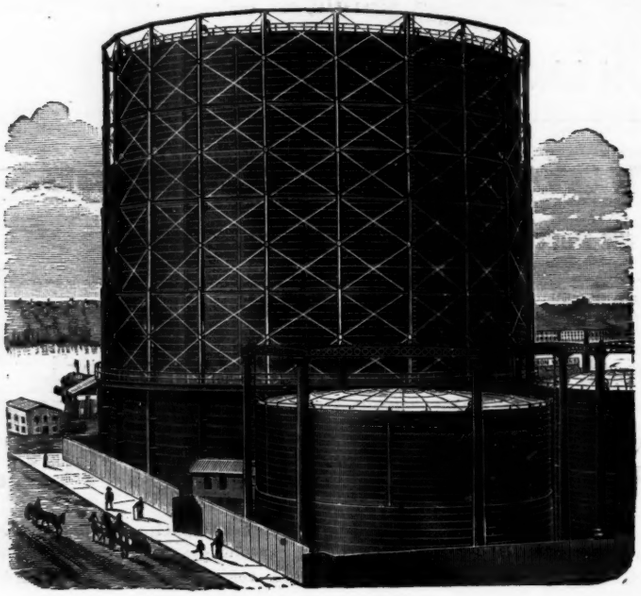

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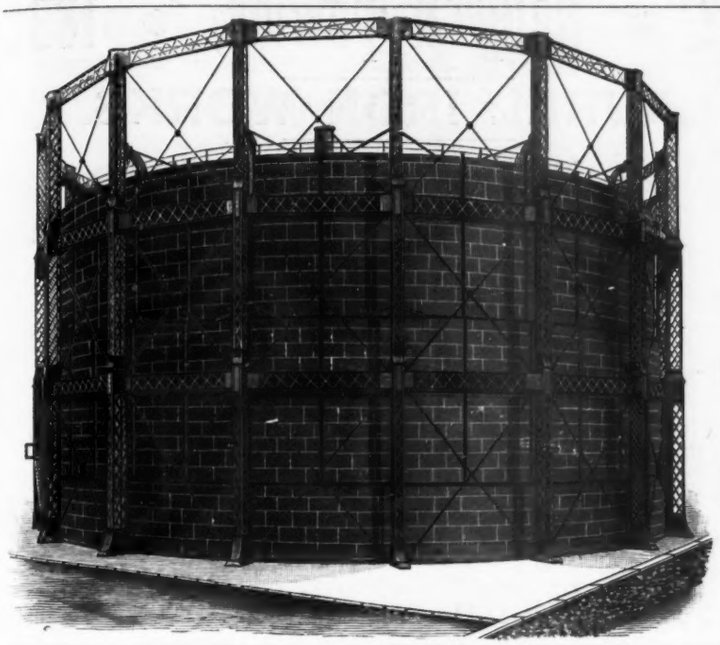

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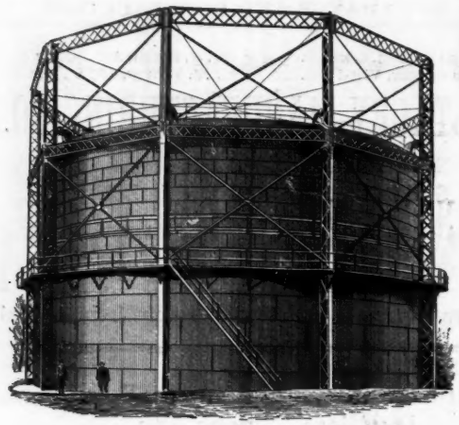

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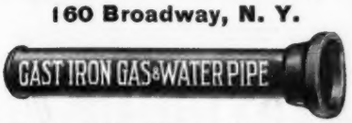

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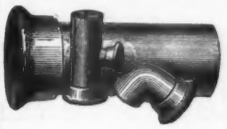

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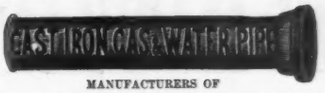

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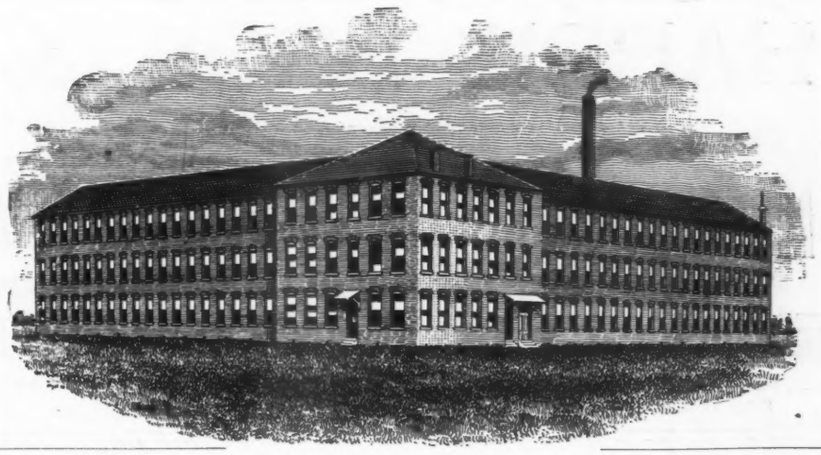

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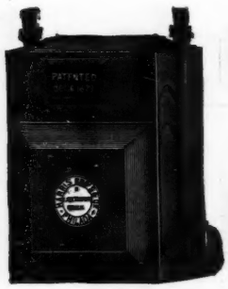

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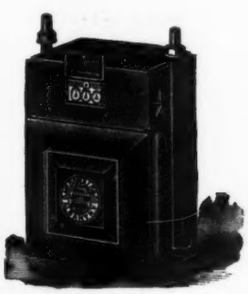

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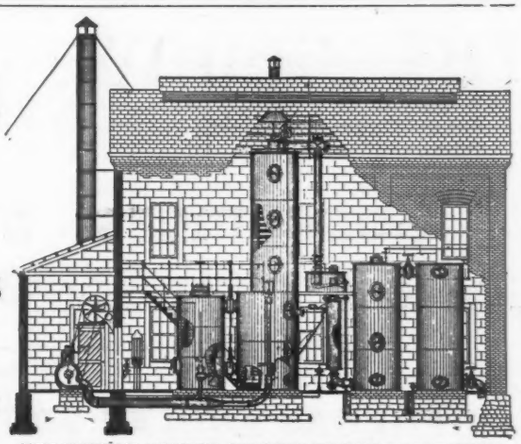

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For efficiency and low gas consumption.
For smooth and quiet running.
For simplicity of construction and grace in design.
For general reliability.
For close regulation of power.

150 MEDALS AND DIPLOMAS.

The "OTTO"--The First.

The First to use the four-stroke cycle. **The First** to admit well measured and distinct charges of gas into an air space. **The First** in the adoption of poppet valves. **The First** to develop the tube igniter, with automatic or timed firing. **The First** to have a reliable electric and a practical magnectic igniter.

THE FIRST SMOOTH RUNNING & NOISELESS GAS ENGINE COMBINING EFFICIENCY & SIMPLICITY.

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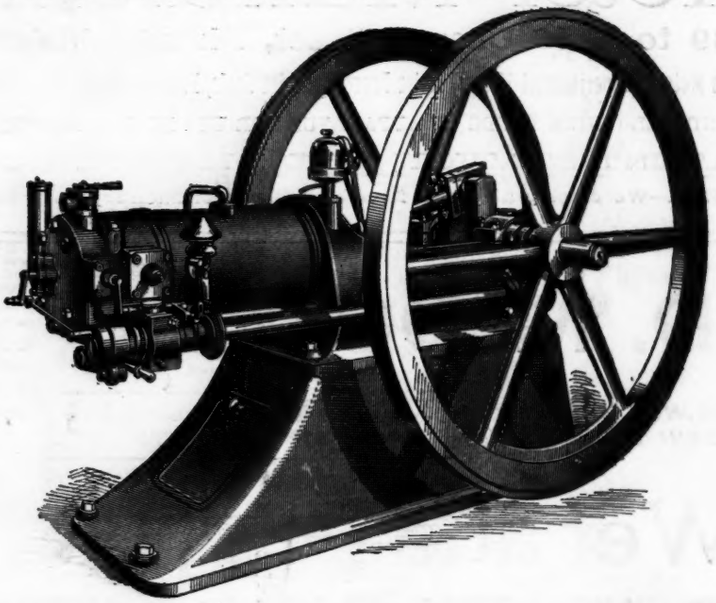
With removable seats and casings for all valves.

With Patent Alloy Tube, good for one year.

With timing device for ignition, preventing starting backward; or with electric igniter.



SIMPLICITY, as far as is possible, with good design and perfect Working. Built on scientific principles, with a view to **HIGHEST EFFICIENCY**

Sizes, 1-3d to 120 H.P.

The First and Only Engine To-day to Please Every Purchaser.

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It is almost a quarter of a century since the "Otto" revolutionized old and bad practices by introducing principles of combustion "entirely new" in the construction of Gas Motors.

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Since its advent the "Otto" engine has been illustrating mechanical improvement without alteration, while others have been offering alterations as improvements.

The experience of the past shows that it requires years to determine the real merits of a gas engine, and that nearly all new gas engines prove failures. **The fittest survive, and the only safe thing to do** in selecting a gas engine is to buy what the tests of practical use, through a long period of time, have proven to be the best.

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